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(54) 名稱

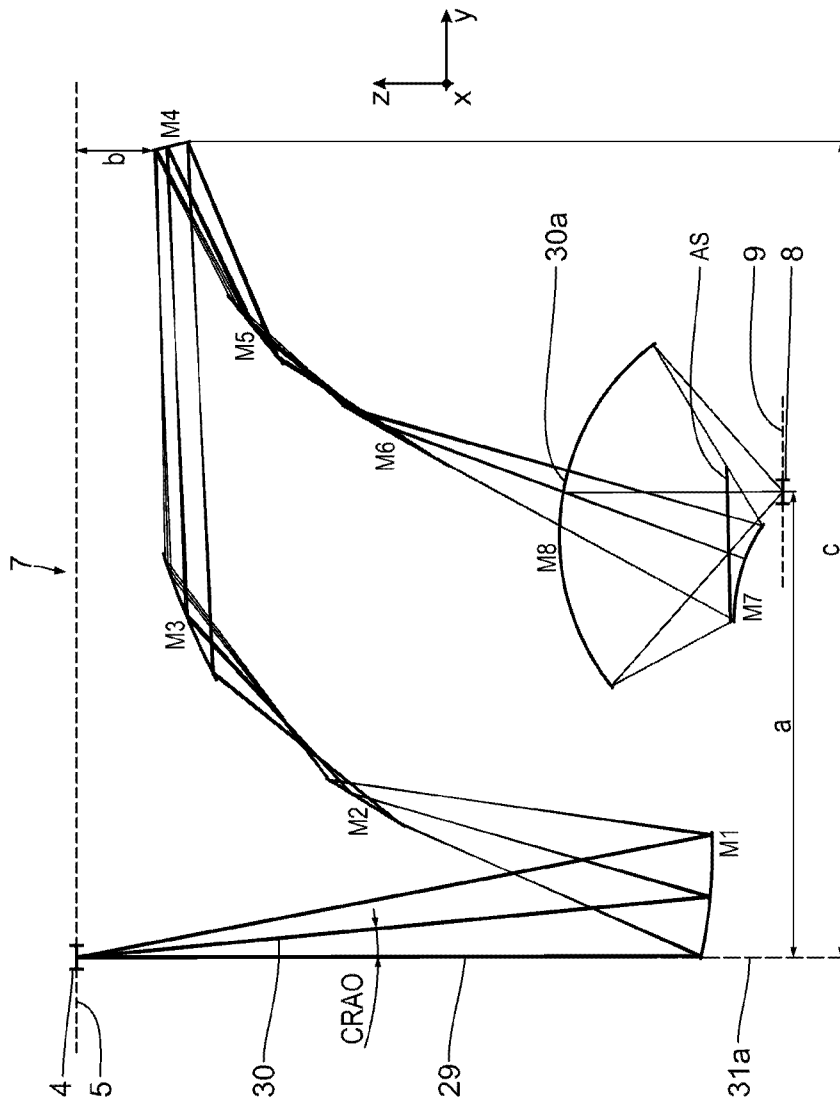
成像光學單元

(57) 摘要

本發明提供一種成像光學單元 (7) 包含複數反射鏡 (M1 至 M8)，其用於將一物件平面 (5) 中的一物件場 (4) 成像到一影像平面 (9) 中的一影像場 (8) 中。影像側數值孔徑係大於 0.55。物件/影像偏移 a 與經向橫向方向 c 之間的比率為至少 0.5。該物件平面 (5) 與該等反射鏡 (M4) 之一最接近於該物件平面之反射部位之間的作業距離 b，與該經向橫向尺寸 c 之間的比率為至少 0.05。該作業距離 b 為至少 270 mm。這產生成像光學單元，其在投影曝光設備中之該使用係盡可能可管理，特別是對於 EUV 投影微影。

An imaging optical unit (7) comprises a plurality of mirrors (M1 to M8) for imaging an object field (4) in an object plane (5) into an image field (8) in an image plane (9). An image-side numerical aperture is greater than 0.55. A ratio between an object/image offset a and a meridional transverse direction c is at least 0.5. A ratio between a working distance b between the object plane (5) and a reflection portion, closest to the object plane, of one of the mirrors (M4) and the meridional transverse dimension c is at least 0.05. The working distance b is at least 270 mm. This yields an imaging optical unit, the use of which is as manageable as possible in a projection exposure apparatus, in particular for EUV projection lithography.

指定代表圖：



符號簡單說明：

- 4:物件場
- 5:物件平面
- 7:成像光學單元
- 8:影像場
- 9:影像平面
- 29:個別光線
- 30:主光線
- 31a:分隔平面
- AS:光闌
- CRAO:角度
- M1、M2、M3、
M4、M5、M6、
M7、M8:反射鏡

【圖2】

【發明摘要】

【中文發明名稱】

成像光學單元

【英文發明名稱】

IMAGING OPTICAL UNIT

【中文】

本發明提供一種成像光學單元（7）包含複數反射鏡（M1至M8），其用於將一物件平面（5）中的一物件場（4）成像到一影像平面（9）中的一影像場（8）中。影像側數值孔徑係大於0.55。物件/影像偏移a與經向橫向方向c之間的比率為至少0.5。該物件平面（5）與該等反射鏡(M4)之一最接近於該物件平面之反射部位之間的作業距離b，與該經向橫向尺寸c之間的比率為至少0.05。該作業距離b為至少270 mm。這產生成像光學單元，其在投影曝光設備中之該使用係盡可能可管理，特別是對於EUV投影微影。

【英文】

An imaging optical unit (7) comprises a plurality of mirrors (M1 to M8) for imaging an object field (4) in an object plane (5) into an image field (8) in an image plane (9). An image-side numerical aperture is greater than 0.55. A ratio between an object/image offset a and a meridional transverse direction c is at least 0.5. A ratio between a working distance b between the object plane (5) and a reflection portion, closest to the object plane, of one of the mirrors (M4) and the meridional transverse dimension c is at least 0.05. The working distance b is at least 270 mm. This yields an imaging optical unit, the use of which is as manageable as possible in a projection exposure apparatus, in particular for EUV projection lithography.

【指定代表圖】圖2

【代表圖之符號簡單說明】

4：物件場

5：物件平面

7：成像光學單元

8：影像場

9：影像平面

29：個別光線

30：主光線

31a：分隔平面

AS：光闌

CRAO：角度

M1、M2、M3、M4、M5、M6、M7、M8：反射鏡

【發明說明書】

【中文發明名稱】

成像光學單元

【英文發明名稱】

IMAGING OPTICAL UNIT

【技術領域】

【0001】 該專利申請案係關於一種成像光學單元包含複數反射鏡，其用於將一物件場成像到該影像場中，前述成像光學單元之該等反射鏡係能夠藉助該測試光學單元測量。又，本發明係關於一種包含此類一成像光學單元的光學系統、一種包含此類一光學系統的照明系統、一種包含此類一照明系統的投影曝光設備、一種用於生成微結構化或奈米結構化部件的方法、和一種藉由任何此類方法而生成的微結構化或奈米結構化部件。

〔交互參照相關申請〕

【0002】 本發明專利申請案主張德國專利申請案DE 10 2021 205 774.8之優先權，其內容係併入文中作為參考。

【先前技術】

【0003】 一開始所闡述的該類型之成像光學單元或投影光學單元係從DE 10 2019 219 209 A1、DE 10 2019 208 961 A1、WO 2009/010213 A1、US 2016/0085061 A1、DE 10 2012 202 675 A1、DE 10 2009 011 328 A1、US 8,027,022 B2 和 US 6,577,443 B2已知。用於投影曝光設備的照明光學單元係從DE 10 2009 045 096 A1已知。

【發明內容】

【0004】 本發明之目的係顯影 (develop) 該引言中所提及的該類型之成像光學單元使得：其在投影曝光設備中的該使用係盡可能可管理，特別是對於EUV投影微影。

【0005】 依據本發明，認可具一方面在該物件/影像偏移與該經向橫向尺寸之間以及另一方面在該作業距離與該經向橫向尺寸之間盡可能大的比率的該成像光學單元之尺寸比率導致成像光學單元，其確保晶圓夾不會與該成像光學單元之上游的照明光學單元之光學部件碰撞（相對較大物件/影像偏移之條件）、確保與用於視需要設計用於更換物件的物件夾的該物件平面相鄰的可用安裝空間足夠（相對較大作業距離）、以及其中容置該投影曝光設備之整個光學單元的可能真空容器無需採用非所需大尺寸（相對較小經向橫向尺寸）製作。

【0006】 具待成像的結構的物件或其一部位係可設置在該物件場中。該等物件結構成像的基板或基板部位係可設置在該影像場中。

【0007】 如請求項1之成像光學單元由於該等給定尺寸比率，而以可管理形式滿足這三項基準 (criteria) 。

【0008】 如請求項2至請求項4用於該物件/影像偏移、用於該作業距離、並用於該經向橫向尺寸的絕對尺寸係得知為特別具優勢。

【0009】 本發明之該等優勢在如請求項5之漸變 (anamorphic) 成像光學單元之該情況下為特別明顯。對應漸變光學單元係從US 9,366,968已知。

【0010】 如請求項6之成像光學單元提供用於高品質結構成像。

【0011】 如請求項7之成像光學單元促進對整個給定影像場大小的良好成像校正。

【0012】 如請求項8和請求項9之成像光學單元已證明其在實務上的價值。可有超過四個GI反射鏡，例如這些可能總共六個或八個。可有超過三個NI反射鏡，例如這些可能總共四個。

【0013】如請求項10之光學系統、如請求項11之照明系統、如請求項12之投影曝光設備、如請求項13之生成方法、和如請求項14之微結構化或奈米結構化部件之該等優勢，對應於已在以上參照依據本發明的該成像光學單元所解說者。

【0014】特別是，半導體部件（例如記憶體晶片）係可生成。

【圖式簡單說明】

【0015】本發明之示例性具體實施例係在以下參照所附圖式更詳細解說，其中：

【0016】圖1示意性顯示用於EUV微影技術的投影曝光設備；

【0017】圖2以經向截面顯示可在依據圖1的該投影曝光設備中用作投影透鏡的成像光學單元之具體實施例，其中用於主光線並用於三個所選擇場點之上彗形像差（coma）光線和下彗形像差光線的成像波束路徑係描繪出；

【0018】圖3以類似於圖7的例示圖顯示可在圖1中該投影曝光設備中用作投影光學單元的成像光學單元之又一具體實施例；

【0019】圖4以類似於圖7的例示圖顯示可在圖1中該投影曝光設備中用作投影光學單元的成像光學單元之又一具體實施例。

【實施方式】

【0020】微影技術投影曝光設備1包含一光源2，其用於照明光或成像光3。光源2係EUV光源，其生成例如在5 nm至30 nm之間、特別是在5 nm至15 nm之間波長範圍內的光。特別是，光源2可為具13.5 nm之波長的光源或具6.9 nm之波長的光源。其他EUV波長也為可能。一般來說，在投影曝光設備1中所引導的照明光3甚至可能具有任何所需波長，例如可見波長或者可能在微影技術（如DUV、深紫外線）中找到用途並可使用合適雷射光源及/或LED光源的其他波長

(如365 nm、248 nm、193 nm、157 nm、129 nm、109 nm)。照明光3之波束路徑係在圖1中非常示意性描繪出。

【0021】 照明光學單元6係用於將來自光源2的照明光3引導到物件平面5中的物件場4。使用投影光學單元或成像光學單元7，物件場4係採用給定可能漸變縮減比例 (scale) 成像到影像平面9中的影像場8。

【0022】 為了促進對投影曝光設備1以及投影光學單元7之該等各種具體實施例進行該說明，直角 (Cartesian 笛卡爾) xyz座標系統係在所附圖式中指示，從該系統該等圖式中所例示的該等部件之該各自定位關係為顯而易見。在圖1中，該x方向垂直於所附圖式之該平面延伸到該後者中。該y方向朝向該左側延伸，而該z方向向上延伸。

【0023】 物件場4和影像場8係矩形。或者，物件場4和影像場8也可能具有彎折或彎曲具體實施例，亦即，特別是部分環形。物件場4和影像場8具有大於1之x/y深寬比。因此，物件場4在該x方向上具有較長物件場尺寸，而在該y方向上具有較短物件場尺寸。這些物件場尺寸沿著該等場座標x和y延伸。

【0024】 圖2、圖3、和圖4中所描繪出的該等示例性具體實施例之一（這仍然將在以下更詳細解說）係可用於投影光學單元7。

【0025】 依據圖2的投影光學單元7具有漸變具體實施例。在該yz平面中，即在依據圖2的該截面之該經向平面中，投影光學單元7具有8之縮減比例 $|\beta_y|$ 。因此，在該經向平面yz中，物件場4係縮減8倍成像到影像場8上。在垂直於該經向面的該縱切面xz中，投影光學單元7之縮減比例 $|\beta_x|$ 為4。在此xz平面中，物件場4因此係縮減4倍成像到物件平面5與影像平面9之間的影像場8中。其他整數或非整數絕對縮減比例 β_x 、 β_y 也為可能，如係將依然在以下基於該等又一示例性具體實施例解說。

【0026】 影像場8具有如26 mm之x範圍，以及如2 mm之y範圍。

【0027】 在依據圖2以及下列等等的投影光學單元7之該等具體實施例中，影像平面9係平行於物件平面5設置。在這種情況下，成像的係與物件場4重

合的反射圖罩10（也指稱為遮罩）之一部位。遮罩10係藉由遮罩夾10a而承載。遮罩夾10a係藉由遮罩移置驅動器10b而移置。

【0028】藉由投影光學單元7的該成像係實行在形式為晶圓（其係藉由基板夾12而承載）的基板11之該表面上。基板夾12係藉由晶圓或基板移置驅動器12a而移置。

【0029】圖1示意性描繪出（在遮罩10與投影光學單元7之間）進入到前述投影光學單元中的照明光3之波束13，以及（在投影光學單元7與基板11之間）從投影光學單元7顯現的照明光3之波束14。在圖1中，投影光學單元7之影像場側數值孔徑（NA）係未按比例再現。

【0030】投影曝光設備1係該掃描器類型。在投影曝光設備1之該操作期間，遮罩10和基板11皆係在該y方向上掃描。投影曝光設備1之步進器類型（其中遮罩10和基板11在該y方向上之步進式移置係在基板11之個別曝光之間實行）也為可能。這些移置係藉由該等移置驅動器10b和12a之適當致動而彼此同步實行。

【0031】圖2顯示投影光學單元7之第一具體實施例之該光學設計。圖2描繪出從圖2中該y方向上彼此間隔開的三個物件場點發出的三個個別光線29（在每種情況下）之該波束路徑。所描繪出係主光線30，即通過投影光學單元7之光瞳平面中光瞳之該中心的個別光線29，以及（在每種情況下）上彗形像差（coma）光線和下彗形像差光線，即通過這兩個物件場點之分別該光瞳之該上與下邊緣的光線。從該物件場4前進，主光線30包含與在物件平面5上的一法線形成的一角度CRAO為 5.05° 。

【0032】投影光學單元7具有0.75之影像側數值孔徑。

【0033】依據圖2的投影光學單元7具有總共八個反射鏡，其（從物件場4前進）係在該等個別光線29之該波束路徑之該順序中編號M1至M8。成像光學單元7也可具有不同數量之反射鏡，例如四個反射鏡、六個反射鏡、九個反射鏡、十個反射鏡、十一個反射鏡、或甚至更多個反射鏡。

【0034】圖2描繪出該等反射鏡M1至M8之該等所計算出反射面。視需要，僅使用這些所計算出反射面之一部位。該等反射面之僅此實際上所使用區域，實際上係存在於該等真實反射鏡M1至M8中。這些所使用反射面係以就其本身已知的方式，藉由反射鏡本體而承載。

【0035】在依據圖2的投影光學單元7中，該等反射鏡M1、M4、M7、和M8係配置為用於正向入射（normal incidence）的反射鏡（NI反射鏡），亦即成像光3以小於 45° 的入射角照射到其上的反射鏡。因此，整體而言，依據圖2的投影光學單元7具有用於正向入射的四個反射鏡M1、M4、M7、和M8。

【0036】該等反射鏡M2、M3、M5、和M6係用於照明光3之掠入射（grazing incidence）的反射鏡（GI反射鏡），亦即照明光3以大於 60° 的入射角照射到其上的反射鏡。成像光3之該等個別光線29在用於掠入射的該等反射鏡M2、M3、M5、和M6上之一般入射角在於 80° 之該區域中。整體而言，依據圖2的投影光學單元7具有用於掠入射的確切四個反射鏡M2、M3、M5、和M6。

【0037】一方面的該等反射鏡M2、M3以及另一方面的M5、M6係設計為成對連續反射鏡並反射成像光3使得：該等個別光線29在一方面的成對M2、M3以及另一方面的成對M5、M6之該等各自反射鏡處之該等反射角相加求和（summate），亦即在該偏轉（deflection）效應方面放大。

【0038】該等反射鏡M1至M8承載最佳化該等反射鏡M1至M8對於成像光3之該反射率的塗層。這可為鈳（ruthenium）塗層、鉬（molybdenum）塗層、或具鈳之最上層的鉬塗層。在用於掠入射的該等反射鏡M2、M3、M5、和M6中，可使用具如一層鉬或鈳的塗層。特別是，用於正向入射的該等反射鏡M1、M4、M7、和M8之這些高度反射層係可配置為多層，其中連續層係可由不同材料製造。也可使用穿插的材料層。一般多層可具有五十個雙層，分別由一層鉬和一層鈳製成。多層可能係提供有附加帽蓋層，例如由鈳製成。

【0039】 為了計算投影光學單元7之整體反射率之該等目的，系統傳輸係可如下計算：反射鏡反射率係基於引導光線（即中心物件場點之主光線）之該入射角在每個反射鏡表面處皆判定，並藉由乘法而組合以形成該系統傳輸。

【0040】 關於該系統傳輸的更多資訊，係可在US 2016/0085061 A1中找到。

【0041】 關於GI反射鏡（grazing incidence mirror，掠入射反射鏡）處的反射的更多資訊，係可在WO 2012/126867 A中找到。關於NI反射鏡（正向入射反射鏡）之該反射率的更多資訊，係可在DE 101 55 711 A中找到。

【0042】 該反射鏡M8（即該成像波束路徑中影像場8之上游的該最終反射鏡）具有用於從該倒數第三反射鏡M6朝向該倒數第二反射鏡M7反射的成像光3之該通道的通道開口30a。該反射鏡M8係在通道開口30a周圍以反射方式使用。所有其他反射鏡M1至M7皆沒有通道開口，並係在以無間隙方式所連接的區域中以反射方式使用。

【0043】 光闌AS係布置在該等反射鏡M6與M7之間的該成像波束路徑中，前述光闌同時具有孔徑光闌之該功能以及遮蔽光闌之該功能。因此，該光闌AS首先指定投影光學單元7之該影像側數值孔徑，並其次指定內光瞳遮蔽之該大小。

【0044】 該光闌AS係可設計為分離光闌，如從US 10,527,832已知。

【0045】 投影光學單元7在該物件側上為大致遠心（telecentric）。若該成像波束路徑係僅關於通過物件場4的該等個別光線列入考慮，則該入射光瞳係位於該xz平面中物件場4之下游4052.44 mm，以及該yz平面中物件場4之下游41876.50 mm。

【0046】 在投影光學單元7中，光瞳平面係存在於成像光3在該等反射鏡M1與M2之間之該波束路徑中。

【0047】 第一中間影像平面係存在於該等反射鏡M2與M3之間的該波束路徑中。又一中間影像平面係存在於該等反射鏡M5與M6之間的該波束路徑中。在投影光學單元7之該情況下，通道開口30a之該區域中沒有中間影像平面。中間

影像平面之該數量不同於依據圖2的該經向平面中的中間影像之該數量，不同於與其垂直的平面中的中間影像之該數量。在相互垂直平面中具中間影像之不同數量的此類投影光學單元，原則上係從WO 2016/166080 A1和DE 10 2015 226 531 A1已知。

【0048】 該光闌AS係位於投影光學單元7之又一光瞳平面之該區域中該等反射鏡M7與M8之間的該波束路徑中。

【0049】 該等反射鏡M1至M8係體現為無法藉由旋轉對稱函數而說明的自由曲面（free-form surfaces）。投影光學單元7之其他具體實施例（其中該等反射鏡M1至M8中至少一者係體現為旋轉對稱非球面）也為可能。所有反射鏡M1至M8皆係也可能體現為此類非球面。

【0050】 自由曲面係可藉由下列自由曲面方程式（方程式1）而說明：

$$Z = \frac{c_x x^2 + c_y y^2}{1 + \sqrt{1 - (1 + k_x)(c_x x)^2 - (1 + k_y)(c_y y)^2}} + C_1 x + C_2 y + C_3 x^2 + C_4 xy + C_5 y^2 + C_6 x^3 + \dots + C_9 y^3 + C_{10} x^4 + \dots + C_{12} x^2 y^2 + \dots + C_{14} y^4 + C_{15} x^5 + \dots + C_{20} y^5 + C_{21} x^6 + \dots + C_{24} x^3 y^3 + \dots + C_{27} y^6 + \dots \quad (1)$$

【0051】 下列適用於此方程式（1）之該等參數：

Z係該點x、y處該自由曲面之該縱切高度，其中 $x^2 + y^2 = r^2$ 。在此，r係與該自由曲面方程式之該參考軸（ $x = 0$ ； $y = 0$ ）的該距離。

【0052】 在該自由曲面方程式（1）中， C_1 、 C_2 、 C_3 ...表示x和y之次方的該自由曲面級數展開之該等係數。

【0053】在圓錐底面積之該情況下， c_x 、 c_y 係對應於對應非球面之該頂點曲率的常數。因此， $c_x = 1/R_x$ 和 $c_y = 1/R_y$ 適用。 k_x 和 k_y 每個皆對應於對應非球面之圓錐常數。因此，方程式（1）說明雙錐自由曲面。

【0054】替代性可能自由曲面係可從旋轉對稱參考表面生成。用於微影技術投影曝光設備之投影光學單元之該等反射鏡之反射面的此類自由曲面，係從US 2007-0058269 A1已知。

【0055】或者，自由曲面係也可借助於二維樣條曲面（spline surfaces）說明。這方面的範例係貝齊爾（Bezier）曲線或非均勻有理B樣條（Non-uniform rational basis spline, NURBS）。藉由範例，二維樣條曲面係可藉由xy平面中的點網格及相關聯z值，或藉由這些點以及與其相關聯的梯度而說明。依該樣條曲面之該各自類型而定，該完整表面係藉由使用如在其該連續性和該可微分性方面具有指定性質的多項式或函數在該等網格點之間的插值而得到。這方面的範例係分析函數。

【0056】投影光學單元7之該等反射鏡M1至M8（= M01至M08）之該等反射面之該光學設計資料係可從下列表格收集。

【0057】這些表格之該第一個提供用於該等光學部件之該等光學表面的頂點半徑（ $\text{Radius}_x = R_x$, $\text{Radius}_y = R_y$ ）和折射能力值（ Power_x , Power_y ）。半徑之負值意指在該各自表面與藉由具曲率之該各自方向的該頂點（x, y）處的表面法線而跨越的該所考慮平面（xz, yz）之該截面中，朝向入射照明光3凹入的曲線。該等兩個半徑 Radius_x 、 Radius_y 明確可能具有不同記號。

【0058】每個光學表面處的該等頂點皆係定義為從物件場中心沿著對稱平面 $x = 0$ （即圖2之所附圖式之該平面（經向平面(meridional plane)））行進到影像場8的引導光線之入射點。

【0059】該等頂點處的該等折射能力 Power_x （ P_x ）、 Power_y （ P_y ）係定義為：

$$P_x = -\frac{2 \cos AOI}{R_x}$$

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$$P_y = -\frac{2}{R_y \cos AOI}$$

在此，AOI表示該引導光線關於該表面法線之入射角。

【0060】該第二個表格明確說明從參考表面前進的該各自反射鏡在該y方向上偏心（ D_y ）、在該z方向上移置（ D_z ）、並傾斜（ $\alpha_x, \alpha_y, \alpha_z$ ）所沿著的該絕對值。這在該自由曲面設計方法之該情況下，對應於平行移位和傾斜。在此，移置係以mm為單位沿著該y方向上並在該z方向上進行，且傾斜係繞著該x軸、繞著該y軸、並繞著該z軸進行。在這種情況下，旋轉之該角度係以度數指定。偏心係首先進行，接著係傾斜。偏心期間的該參考表面在每種情況下皆係該所指定光學設計資料之該第一表面。該y方向上以及該z方向上的偏心係也指定用於物件場4（遮罩）。除了分派給該等個別反射鏡M1至M8的該等值之外，此表格也將該物件平面（遮罩）製表為第一表面、將該影像平面（晶圓）製表為最終表面，並將光闌表面（表示「光闌」（stop））製表為用於孔徑或遮蔽光闌的設置平面。

【0061】該第三個表格（表3a至表3c）明確說明用於該等反射鏡M1至M8的該等自由形式表面係數 C_n （分別分派給該等多項式 x^k, y^l ）。未製表的係數 C_n 每個皆具有0之值。

【0062】該第四個表格將該光闌AS之邊界明確說明為局部座標xy中的多邊形鏈。如以上所說明，該光闌仍然為偏心且傾斜。在此表格中，該等座標係在兩行中明確說明。該第一行（由x與y座標構成）內含該多邊形之該等角落1至M/2之該等座標，且該第二行內含該等角落N/2+1至N之該等座標。因此，每列皆內含四個數量，具體而言 $x_i, y_i, x_{i+N/2}, y_{i+N/2}$ 。

【0063】該等表面之半徑

	Radius _x [mm]	Power _x [1/mm]	Radius _y [mm]	Power _y [1/mm]
M01	-4034.99337674	0.00048480	-1919.37995952	0.00101917
M02	2920.41917039	-0.00008695	11587.03874383	-0.00002192
M03	-26015.99761308	0.00003162	-3094.46673369	0.00026583
M04	-2953.96843662	0.00066710	-3212.98631374	0.00061332
M05	-6775.34133198	0.00008890	-6077.62957307	0.00009911

M06	153274.17405730	-0.00000042	11112.52442081	-0.00000576
M07	9368.75423580	-0.00018587	596.79271790	-0.00291783
M08	-1010.31540632	0.00194976	-863.43988213	0.00228143

用於圖2的表1

【0064】 偏心（位置、角度）該等表面

	D_x [mm]	D_y [mm]	D_z [mm]
Reticle	0.000000000	0.000000000	0.000000000
M01	0.000000000	-215.931440053	2242.533747038
M02	0.000000000	-581.615773686	972.087125641
M03	0.000000000	-1211.474170454	389.630407074
M04	0.000000000	-2870.974936716	320.829470405
M05	0.000000000	-2227.616068614	627.737948335
M06	0.000000000	-1901.343414992	1040.317765822
M07	-0.000000000	-1411.845146534	2366.757744378
Stop	-0.000000000	-1433.339697092	2308.511917952
M08	0.000000000	-1649.877036267	1721.740110900
Wafer	-0.000000000	-1649.832513636	2500.204827932

	α_x [°]	α_y [°]	α_z [°]
Reticle	0.000000000	0.000000000	0.000000000
M01	-5.278946214	0.000000000	0.000000000
M02	58.351487888	180.000000000	0.000000000
M03	202.567461898	0.000000000	0.000000000
M04	-76.061447244	180.000000000	0.000000000
M05	218.582857583	0.000000000	0.000000000
M06	60.703505424	180.000000000	0.000000000
M07	-20.255654399	-0.000000000	-0.000000000
Stop	1.326318383	180.000000000	-0.000000000
M08	-10.129465655	180.000000000	-0.000000000
Wafer	-0.003276910	-0.000000000	0.000000000

用於圖2的表2

【0065】 該等表面之自由形式係數

係數	公式	M01	M02	M03
C7	$x^2 y$	2.1521350904e-08	1.1787316958e-07	-1.4132123554e-07
C9	y^3	8.7024735141e-09	-3.3367018008e-07	3.9356983474e-08
C10	x^4	5.5560957075e-12	3.4025225495e-11	-6.5750183525e-11
C12	$x^2 y^2$	7.5032152159e-12	-1.9736140793e-10	7.6565679325e-11
C14	y^4	-3.9878920961e-11	8.3176214710e-10	7.4538149503e-12
C16	$x^4 y$	1.9761473535e-14	9.7263173621e-14	3.5762077821e-14
C18	$x^2 y^3$	4.9899022378e-14	7.9538468016e-14	-2.2829082429e-14

C20	y^5	-7.9997851101e-14	-2.0149908433e-12	-5.5078057337e-14
C21	x^6	6.7688627599e-18	-1.1837742413e-17	1.9487417140e-18
C23	$x^4 y^2$	6.2287464539e-18	2.1507653236e-16	1.4070268782e-17
C25	$x^2 y^4$	8.9820067762e-17	-2.8579314403e-16	-4.9037732040e-17
C27	y^6	-1.7199085361e-16	6.9745386669e-15	7.5895230730e-17
C29	$x^6 y$	-7.9726966250e-21	2.4802802663e-19	2.0013048846e-20
C31	$x^4 y^3$	-2.2580790713e-20	-9.7206078620e-19	-5.7407912103e-20
C33	$x^2 y^5$	1.2004739572e-19	-1.0648476929e-19	2.0650200707e-20
C35	y^7	-1.4869410891e-21	-1.2608475036e-17	4.5515851277e-19
C36	x^8	-5.9918913447e-24	3.2759947243e-22	5.7195698345e-23
C38	$x^6 y^2$	3.8210947146e-24	-1.2399767203e-22	-6.1461254760e-23
C40	$x^4 y^4$	2.3657574745e-23	9.9003718858e-22	2.0211891359e-22
C42	$x^2 y^6$	-3.5893911196e-23	2.5795548778e-21	2.5989240605e-21
C44	y^8	1.0862009204e-21	-2.1799987369e-19	-3.9696603728e-22
C46	$x^8 y$	2.7623417895e-26	1.9187001763e-26	-1.1898117464e-25
C48	$x^6 y^3$	3.2302452678e-25	-5.7877652911e-25	2.3993987486e-25
C50	$x^4 y^5$	2.3212765682e-24	1.0036656167e-23	2.0979738694e-24
C52	$x^2 y^7$	-2.9540953870e-24	1.0845106904e-22	-9.2125961341e-24
C54	y^9	-1.9775620518e-23	1.8791932171e-21	-3.6054702892e-23
C55	x^{10}	-7.8656225734e-31	-1.1426249301e-27	-2.2725313266e-28
C57	$x^8 y^2$	-8.6492497072e-29	4.8911298402e-27	4.5835274737e-28
C59	$x^6 y^4$	-2.5458706650e-27	5.8300212318e-27	-1.6449310234e-28
C61	$x^4 y^6$	1.0727981205e-27	-3.0794278556e-26	-3.1071106797e-26
C63	$x^2 y^8$	-5.9157827970e-27	-1.2558855465e-24	-1.6560734754e-25
C65	y^{10}	-1.9658357053e-25	-3.2949399728e-24	1.2704474400e-25
C67	$x^{10} y$	-1.0763473925e-31	1.0453631883e-30	5.6807442176e-31
C69	$x^8 y^3$	-3.1619674535e-30	1.2274256167e-29	-1.5423191780e-31
C71	$x^6 y^5$	-3.6302312311e-29	1.3105506757e-28	-2.1528307642e-29
C73	$x^4 y^7$	-9.0724878973e-29	-2.5212060185e-27	-8.4338804346e-29
C75	$x^2 y^9$	2.1818185390e-28	-5.9079606952e-27	7.4194764024e-28
C77	y^{11}	-1.1731058142e-28	-2.3664039350e-26	1.0068178666e-27
C78	x^{12}	1.1859547340e-34	4.6569698415e-33	2.0928678345e-34
C80	$x^{10} y^2$	8.0754311628e-34	-5.2503795225e-32	-2.0835452019e-33
C82	$x^8 y^4$	2.7117648894e-32	4.4038353142e-32	-4.9505362121e-33
C84	$x^6 y^6$	2.1371956884e-31	-9.5358323891e-31	9.0318380750e-32
C86	$x^4 y^8$	-9.0437590127e-32	2.1126113378e-29	2.1301887206e-30
C88	$x^2 y^{10}$	1.5464341810e-30	1.4749252853e-28	5.8117607059e-30
C90	y^{12}	3.9640791475e-30	1.6823058962e-28	-5.3769877539e-30
C92	$x^{12} y$	3.6566336252e-37	3.9960551727e-35	-1.8005079646e-36
C94	$x^{10} y^3$	1.5740653862e-35	6.3186990963e-35	-1.4177462413e-35
C96	$x^8 y^5$	2.3437356064e-34	-3.2083538854e-33	4.5602299584e-35
C98	$x^6 y^7$	1.5224165082e-33	-8.7996119915e-34	1.0275489722e-33
C100	$x^4 y^9$	2.4585083713e-34	1.5999608638e-31	6.5014081591e-34

C102	$x^2 y^{11}$	-6.7057882610e-34	-2.1476462249e-31	-2.5737947868e-32
C104	y^{13}	8.5612655825e-33	1.4165280832e-31	-1.4773288630e-32
C105	x^{14}	-5.0629738724e-40	-1.6613826132e-38	8.2934045453e-40
C107	$x^{12} y^2$	-2.9228885198e-39	5.7332753831e-37	1.9455944074e-39
C109	$x^{10} y^4$	-1.3732735962e-37	-1.4722825961e-36	1.3250679569e-40
C111	$x^8 y^6$	-1.8821837369e-36	6.0412526109e-36	-6.8798222979e-38
C113	$x^6 y^8$	-7.1669783192e-36	1.1533223185e-35	-6.8321084910e-36
C115	$x^4 y^{10}$	2.6980183245e-36	-2.4424274448e-33	-7.3177564183e-35
C117	$x^2 y^{12}$	-3.2695372702e-35	-7.4338389363e-33	-1.1561720127e-34
C119	y^{14}	-2.2061944591e-35	-1.2105673148e-32	1.1743710862e-34
C121	$x^{14} y$	-1.5117318447e-42	-2.3935729252e-40	2.8729291230e-42
C123	$x^{12} y^3$	-3.7673388736e-41	-1.1438639618e-39	9.6607924020e-41
C125	$x^{10} y^5$	-8.9668820572e-40	1.9296715371e-38	2.3637253908e-40
C127	$x^8 y^7$	-6.4444995226e-39	1.6954135404e-37	-2.3722052788e-39
C129	$x^6 y^9$	-3.1133119253e-38	4.1128177470e-38	-1.7067490431e-38
C131	$x^4 y^{11}$	5.6003617485e-38	4.6354160402e-36	2.7522436870e-38
C133	$x^2 y^{13}$	-1.3393429419e-37	5.4493236330e-35	4.4362813883e-37
C135	y^{15}	-8.8106147316e-38	9.9192863836e-35	7.6420972557e-38
C136	x^{16}	9.6154995568e-46	8.5297756139e-44	-3.4184161211e-45
C138	$x^{14} y^2$	6.7746448350e-45	-3.1863970035e-42	1.8274751399e-44
C140	$x^{12} y^4$	3.4257874836e-43	9.4655639529e-42	1.9667036469e-43
C142	$x^{10} y^6$	6.7068589418e-42	3.1566917339e-41	4.1973634791e-43
C144	$x^8 y^8$	4.8132117640e-41	-8.6577384776e-40	1.4656676566e-41
C146	$x^6 y^{10}$	9.5499786182e-41	2.4587656881e-39	1.6669776050e-40
C148	$x^4 y^{12}$	4.1344982064e-41	5.3381961023e-38	1.3146865269e-39
C150	$x^2 y^{14}$	-4.1983194544e-42	-1.5991093786e-37	1.1388831730e-39
C152	y^{16}	-3.2387947839e-40	-3.8089349527e-37	-1.22443872226e-39
C154	$x^{16} y$	2.7813838445e-48	6.6042019465e-46	1.9425833013e-49
C156	$x^{14} y^3$	2.7146181955e-47	5.7160365834e-45	-1.9339907360e-46
C158	$x^{12} y^5$	1.2332440828e-45	-2.8888344096e-44	-1.0515363766e-45
C160	$x^{10} y^7$	1.2483967050e-44	-5.8153596336e-43	1.5316944697e-45
C162	$x^8 y^9$	5.6496635012e-44	-2.4317993102e-42	6.5153788043e-45
C164	$x^6 y^{11}$	2.5065946151e-43	-2.4067164278e-41	1.5951592987e-43
C166	$x^4 y^{13}$	-9.9208048186e-43	-2.8832467322e-40	-6.5233797249e-43
C168	$x^2 y^{15}$	2.5987717141e-42	2.1215687366e-40	-2.7704535512e-42
C170	y^{17}	-9.7463316249e-43	7.2212195135e-40	-3.3529825374e-44
C171	x^{18}	-7.6877343532e-52	-1.2241128080e-49	3.6512857520e-51
C173	$x^{16} y^2$	-9.8514184953e-51	8.3091980783e-48	-4.3883060351e-50
C175	$x^{14} y^4$	-3.1668123053e-49	-6.7731554852e-48	-6.8194662879e-49
C177	$x^{12} y^6$	-9.1485218816e-48	-1.8925844722e-46	-1.6981489713e-48
C179	$x^{10} y^8$	-8.6066486288e-47	1.9622506386e-45	-3.1046718597e-47
C181	$x^8 y^{10}$	-4.2346481695e-46	1.6072975736e-44	-1.5367380933e-46
C183	$x^6 y^{12}$	-3.0153790442e-46	5.3471372986e-44	-1.7408374500e-45

C185	$x^4 y^{14}$	-1.9632777042e-45	4.1871053244e-43	-8.9549573898e-45
C187	$x^2 y^{16}$	7.0003037571e-45	-1.0664888409e-43	-5.0794796208e-45
C189	y^{18}	-4.7581812824e-46	-5.4126862903e-43	5.2086604563e-45

用於圖2的表3a

係數	公式	M04	M05	M06
C7	$x^2 y$	2.1660952734e-08	3.1333885220e-08	-3.3030773408e-08
C9	y^3	3.9266375372e-08	5.0988995907e-08	-2.9178103112e-08
C10	x^4	2.8829949631e-12	-4.8249179223e-13	6.7529892237e-11
C12	$x^2 y^2$	1.1253311565e-10	-3.0274062932e-11	8.0570609182e-11
C14	y^4	4.3077253594e-10	-8.5400978420e-11	5.1962046362e-11
C16	$x^4 y$	1.5843061838e-14	-9.2516756288e-15	7.0685883753e-14
C18	$x^2 y^3$	3.5040147006e-13	-2.5611651479e-14	3.0604682247e-14
C20	y^5	-1.0474638103e-12	1.8578320289e-13	-5.6179910868e-14
C21	x^6	1.0293405300e-18	8.5967220986e-18	-1.6735697691e-16
C23	$x^4 y^2$	7.9434013734e-17	3.6705182502e-17	5.7859209076e-16
C25	$x^2 y^4$	9.0120514561e-16	1.5039899738e-16	-2.8688402112e-16
C27	y^6	-2.2374733431e-14	-4.1879219875e-16	7.3923810896e-16
C29	$x^6 y$	1.0226788796e-20	-2.9562274975e-20	-5.0026120248e-19
C31	$x^4 y^3$	2.2769066499e-19	5.6781871174e-21	1.6634301383e-18
C33	$x^2 y^5$	-1.6872068907e-17	-5.3417521961e-19	-2.7189191125e-18
C35	y^7	-1.2783950389e-16	9.6964121839e-19	-1.5469681891e-17
C36	x^8	-1.7971363712e-24	2.1622792330e-22	-6.3269019016e-21
C38	$x^6 y^2$	3.1525788327e-23	-1.5616915290e-22	-3.5266205499e-21
C40	$x^4 y^4$	-3.0162742950e-21	-1.1434360642e-21	-5.4681625969e-20
C42	$x^2 y^6$	1.7332353923e-19	-7.7718331673e-22	3.6130768205e-20
C44	y^8	2.1593432167e-17	-7.9333587218e-21	6.4890060940e-20
C46	$x^8 y$	-1.5390653103e-27	-7.8435745509e-25	-2.2831990708e-22
C48	$x^6 y^3$	8.8568076913e-25	1.0155690743e-24	3.8060229125e-22
C50	$x^4 y^5$	1.5519454651e-22	7.5599473736e-24	4.8848696934e-22
C52	$x^2 y^7$	1.6189164310e-20	4.8909071330e-26	-2.9627761818e-22
C54	y^9	7.9652339881e-20	6.6138481693e-23	8.2333391252e-22
C55	x^{10}	5.9094480530e-30	-2.6077557400e-27	7.0809951961e-25
C57	$x^8 y^2$	2.6809201148e-28	3.2771923020e-27	-3.6506220356e-24
C59	$x^6 y^4$	6.1333047370e-26	7.6108243931e-27	-2.1544477960e-24
C61	$x^4 y^6$	7.1838124486e-24	3.7933919694e-26	1.1745883624e-23
C63	$x^2 y^8$	-9.1098026402e-24	1.3794443835e-25	2.6315555304e-24
C65	y^{10}	-4.3457989750e-21	2.3404380085e-25	-8.6844242237e-24
C67	$x^{10} y$	1.4784475567e-32	1.4678117646e-29	2.0691255128e-26
C69	$x^8 y^3$	4.1923693697e-30	-1.9763343438e-29	-5.0658919158e-26
C71	$x^6 y^5$	8.1823569000e-28	-1.0730104633e-28	-1.9099808443e-25
C73	$x^4 y^7$	-3.0128056195e-26	-3.6782086540e-28	-1.4075411360e-25

C75	$x^2 y^9$	-2.9490517356e-24	-5.1710044246e-28	2.4493963042e-26
C77	y^{11}	-1.9094350088e-23	-4.5276503089e-27	3.3907003478e-27
C78	x^{12}	-5.7249163483e-36	1.4006486404e-32	-3.2017705884e-29
C80	$x^{10} y^2$	-1.1201070735e-33	-4.5922239946e-32	3.4008842678e-28
C82	$x^8 y^4$	-2.0366019740e-31	-9.8693256802e-33	1.1576925077e-27
C84	$x^6 y^6$	-4.0937814696e-29	1.8239826155e-31	8.9515522467e-28
C86	$x^4 y^8$	-2.1648505724e-27	-3.0389746406e-30	-7.8567743843e-28
C88	$x^2 y^{10}$	8.1759146860e-27	7.5865748174e-31	-5.6053032642e-28
C90	y^{12}	8.2108120807e-25	-1.2538187576e-29	3.3365316022e-28
C92	$x^{12} y$	-5.0548663615e-38	-1.1129185971e-34	-8.8522950187e-31
C94	$x^{10} y^3$	-3.1655268140e-35	2.1883222778e-34	2.3936539218e-30
C96	$x^8 y^5$	-5.5380485066e-33	7.0423680847e-34	1.8305172115e-29
C98	$x^6 y^7$	-5.2430548906e-31	4.5199562366e-33	2.3409101496e-29
C100	$x^4 y^9$	1.3841354578e-30	1.4819899436e-32	1.4533837941e-29
C102	$x^2 y^{11}$	4.0971323331e-28	2.6880636940e-32	1.9194019601e-30
C104	y^{13}	7.7252252576e-27	1.9784236502e-31	-1.8471281396e-30
C105	x^{14}	9.8475230978e-43	-3.6370268719e-38	8.2490268399e-34
C107	$x^{12} y^2$	2.8178788967e-39	3.5966308029e-37	-1.2060908669e-32
C109	$x^{10} y^4$	5.8382973814e-37	-5.5591258757e-37	-1.0382424031e-31
C111	$x^8 y^6$	1.1214426294e-34	-5.6556460782e-36	-1.9127253782e-31
C113	$x^6 y^8$	1.1959744206e-32	-7.9641220855e-37	-1.2906119442e-31
C115	$x^4 y^{10}$	3.4940308615e-31	9.2565610063e-35	-1.8452868801e-32
C117	$x^2 y^{12}$	6.0329842175e-31	-2.5886142734e-34	1.8181955925e-32
C119	y^{14}	-7.0908670479e-29	3.6271206303e-34	2.0990219072e-33
C121	$x^{14} y$	2.3792130662e-43	3.9088709301e-40	1.8602086752e-35
C123	$x^{12} y^3$	1.4707237924e-40	-1.1188883361e-39	-3.0763841122e-35
C125	$x^{10} y^5$	2.4672375126e-38	-2.3699864032e-39	-8.1322782953e-34
C127	$x^8 y^7$	3.4227240925e-36	2.0057033331e-38	-1.5331720682e-33
C129	$x^6 y^9$	2.0832562823e-34	-2.6451985749e-37	-7.4089031221e-34
C131	$x^4 y^{11}$	1.5835026840e-33	4.3633522737e-38	-4.8347995938e-34
C133	$x^2 y^{13}$	-2.2911046663e-33	-1.3151815707e-36	-1.8530290775e-34
C135	y^{15}	-1.6496976386e-30	-3.9484767292e-36	1.5723430812e-35
C136	x^{16}	1.8372055185e-48	2.9810793335e-44	-1.1835863906e-38
C138	$x^{14} y^2$	1.1874709611e-45	-1.4245325924e-42	1.5398085471e-37
C140	$x^{12} y^4$	9.0478679352e-43	4.7893823268e-42	3.5981573888e-36
C142	$x^{10} y^6$	5.3039437925e-41	1.8905276850e-41	1.1862951148e-35
C144	$x^8 y^8$	7.8290181860e-39	8.9415133170e-41	1.1246102269e-35
C146	$x^6 y^{10}$	-1.0240940043e-37	8.8169810814e-41	6.3837515450e-36
C148	$x^4 y^{12}$	1.9558769764e-36	-1.1878759927e-39	2.8731472061e-36
C150	$x^2 y^{14}$	-3.9953984319e-34	8.2436940391e-39	6.8875254803e-37
C152	y^{16}	-5.6474117066e-33	-4.9413402019e-39	-7.1767252149e-38
C154	$x^{16} y$	-2.4582159279e-49	-4.4754643934e-46	-1.5161616370e-40
C156	$x^{14} y^3$	-1.4054112660e-46	2.1265553221e-45	-1.8177014275e-40

C158	$x^{12}y^5$	-2.2495426009e-44	5.4790861578e-45	1.1798635482e-38
C160	$x^{10}y^7$	-3.1894132838e-42	-2.4474717948e-43	4.1957974177e-38
C162	x^8y^9	-3.6464445135e-40	3.5133942366e-43	2.1503331297e-38
C164	x^6y^{11}	-1.2290909798e-38	3.5286185580e-42	-1.3018838762e-38
C166	x^4y^{13}	8.5007476807e-38	-6.8933145997e-42	-6.4734628027e-39
C168	x^2y^{15}	-8.9963822447e-36	2.5472093319e-41	-1.2121353441e-39
C170	y^{17}	6.6478733266e-35	2.6090514385e-41	1.2275453894e-40
C171	x^{18}	4.6272517509e-54	-6.1164806513e-51	7.4096377325e-44
C173	$x^{16}y^2$	-3.5872296762e-51	1.9622190489e-48	-1.3119648435e-43
C175	$x^{14}y^4$	-2.0307680444e-48	-1.1885161644e-47	-4.0756534693e-41
C177	$x^{12}y^6$	-1.1410294961e-46	6.1260900289e-48	-2.3417244739e-40
C179	$x^{10}y^8$	-3.0791539834e-44	7.6867496312e-46	-3.6340725269e-40
C181	x^8y^{10}	-1.9471591420e-42	-4.8265841146e-45	-1.4648853682e-40
C183	x^6y^{12}	-4.9547550378e-41	9.0439183673e-45	6.5485699735e-42
C185	x^4y^{14}	6.0840560058e-40	-1.7952807242e-44	5.3789642146e-42
C187	x^2y^{16}	-4.8904884769e-38	-5.1391405664e-44	8.4380197977e-43
C189	y^{18}	4.4662799106e-37	-8.0430224445e-45	-7.9420102979e-44

用於圖2的表3b

係數	公式	M07	M08
C7	x^2y	6.7510679990e-07	-7.7684263707e-09
C9	y^3	-5.9605264564e-07	2.1186549975e-08
C10	x^4	4.1200148248e-10	-1.3310403721e-11
C12	x^2y^2	1.1715196527e-09	-5.7800895944e-11
C14	y^4	2.4710611185e-09	-1.5516852239e-11
C16	x^4y	1.0445145338e-12	-2.0718067078e-14
C18	x^2y^3	3.3558525987e-12	3.6299639507e-15
C20	y^5	-7.4601451659e-12	2.1620702858e-14
C21	x^6	5.0072064430e-16	-2.4229167358e-17
C23	x^4y^2	5.2767006042e-15	-1.0548493781e-16
C25	x^2y^4	8.5560393410e-16	-1.1165691898e-16
C27	y^6	2.5775475069e-14	-2.5526161155e-17
C29	x^6y	3.7719755046e-18	-2.2500133737e-20
C31	x^4y^3	1.0758424722e-17	-2.3604770801e-20
C33	x^2y^5	2.3536379321e-17	2.3845503163e-20
C35	y^7	-1.2253201631e-16	2.6664564603e-20
C36	x^8	1.8038046924e-21	-3.5210099395e-23
C38	x^6y^2	1.7289657924e-20	-1.4918697711e-22
C40	x^4y^4	5.2859525033e-20	-2.6237911344e-22
C42	x^2y^6	-8.6172650997e-20	-1.7442521586e-22
C44	y^8	4.4773496698e-19	-3.3239236285e-23
C46	x^8y	1.0430729603e-23	-1.6816135464e-26

C48	$x^6 y^3$	6.1382946192e-23	-6.1657425487e-26
C50	$x^4 y^5$	-1.0182272562e-22	-6.3859678615e-27
C52	$x^2 y^7$	7.1501654697e-22	5.3937593439e-26
C54	y^9	1.4931885109e-21	2.2296280167e-26
C55	x^{10}	3.4404619172e-27	-2.5536857170e-29
C57	$x^8 y^2$	6.4380020942e-26	-3.0366300957e-28
C59	$x^6 y^4$	2.5302993381e-25	-8.0003335407e-28
C61	$x^4 y^6$	1.8618106087e-24	-9.3817108107e-28
C63	$x^2 y^8$	7.3440727184e-24	-4.6308049926e-28
C65	y^{10}	7.4647804866e-24	-9.8178685527e-29
C67	$x^{10} y$	1.1440401751e-30	-1.3864315114e-32
C69	$x^8 y^3$	3.3217918985e-28	2.3417171712e-32
C71	$x^6 y^5$	5.0384292903e-27	-7.9386096984e-32
C73	$x^4 y^7$	1.8210552798e-26	-6.8860896221e-32
C75	$x^2 y^9$	-2.6956396141e-26	2.0751570670e-32
C77	y^{11}	-3.5269592340e-25	5.4840794182e-32
C78	x^{12}	-1.1234632058e-32	-1.3769950006e-35
C80	$x^{10} y^2$	4.7186915408e-31	4.2029120402e-34
C82	$x^8 y^4$	2.1285995883e-30	2.1957036679e-33
C84	$x^6 y^6$	-1.6468197623e-29	4.5028855850e-33
C86	$x^4 y^8$	-1.6241805572e-28	3.8876609446e-33
C88	$x^2 y^{10}$	-1.0312773446e-27	1.2177064184e-33
C90	y^{12}	9.9848578534e-28	2.0141536991e-34
C92	$x^{12} y$	1.2130539368e-33	-2.8165022925e-37
C94	$x^{10} y^3$	1.0868832417e-32	-1.3463299808e-36
C96	$x^8 y^5$	-4.8488251769e-32	-1.3639608169e-36
C98	$x^6 y^7$	-5.0885258398e-31	5.4967599013e-37
C100	$x^4 y^9$	-1.5414116455e-30	1.7232300858e-36
C102	$x^2 y^{11}$	5.4469618398e-30	1.2942820721e-36
C104	y^{13}	1.6117823620e-29	1.9699596918e-37
C105	x^{14}	3.6424134489e-37	-2.0147701926e-40
C107	$x^{12} y^2$	4.8125995924e-37	-3.9820831972e-39
C109	$x^{10} y^4$	-1.6734061278e-35	-2.1401906247e-38
C111	$x^8 y^6$	2.7653631914e-34	-5.3204956769e-38
C113	$x^6 y^8$	2.7717555838e-33	-6.6483746748e-38
C115	$x^4 y^{10}$	1.6209234047e-32	-4.2702056479e-38
C117	$x^2 y^{12}$	5.4830736686e-32	-1.1212638402e-38
C119	y^{14}	-9.6951394448e-32	-1.2358247201e-39
C121	$x^{14} y$	-1.5196063181e-38	1.0591089247e-42
C123	$x^{12} y^3$	-2.4346275366e-37	6.0081477285e-42
C125	$x^{10} y^5$	-1.7784052936e-37	1.0106381940e-41
C127	$x^8 y^7$	7.9571519310e-36	2.3631473323e-42
C129	$x^6 y^9$	3.3932330746e-35	-1.0791273202e-41

C131	$x^4 y^{11}$	5.6171604467e-35	-1.2198174714e-41
C133	$x^2 y^{13}$	-4.5020966892e-34	-7.1232053298e-42
C135	y^{15}	-3.0444101717e-34	-1.2675299720e-42
C136	x^{16}	-3.1397860935e-42	5.5289642085e-46
C138	$x^{14} y^2$	-3.6764526616e-41	1.2408953942e-44
C140	$x^{12} y^4$	5.1682281559e-41	8.0360655159e-44
C142	$x^{10} y^6$	-7.5724070624e-40	2.5002877427e-43
C144	$x^8 y^8$	-3.5242758525e-38	4.1567843534e-43
C146	$x^6 y^{10}$	-1.9290295406e-37	3.8776740206e-43
C148	$x^4 y^{12}$	-8.9279321053e-37	1.9801753831e-43
C150	$x^2 y^{14}$	-1.0610618019e-36	4.1515399107e-44
C152	y^{16}	4.2032564742e-36	3.3189488097e-45
C154	$x^{16} y$	1.3900490222e-43	-2.6714733976e-48
C156	$x^{14} y^3$	3.1948332019e-42	-1.9023703003e-47
C158	$x^{12} y^5$	1.5572932617e-41	-4.6866351175e-47
C160	$x^{10} y^7$	-3.5961276855e-41	-4.3208550927e-47
C162	$x^8 y^9$	-4.4994909187e-40	2.0571387485e-47
C164	$x^6 y^{11}$	-1.1517175255e-39	6.8011061355e-47
C166	$x^4 y^{13}$	-4.0441034977e-40	5.6874752660e-47
C168	$x^2 y^{15}$	1.8548402473e-38	2.8250025956e-47
C170	y^{17}	-8.9835721083e-39	5.3246951685e-48
C171	x^{18}	2.3986122130e-47	-1.4577504922e-51
C173	$x^{16} y^2$	8.1475450191e-46	-3.0082090032e-50
C175	$x^{14} y^4$	7.3884777256e-45	-2.1208177229e-49
C177	$x^{12} y^6$	2.7542991108e-44	-7.6436443269e-49
C179	$x^{10} y^8$	1.8164049336e-43	-1.5713795144e-48
C181	$x^8 y^{10}$	1.9780808155e-42	-1.9352435230e-48
C183	$x^6 y^{12}$	6.6873956729e-42	-1.4362747907e-48
C185	$x^4 y^{14}$	2.8702380925e-41	-6.1025451080e-49
C187	$x^2 y^{16}$	-3.1866212691e-41	-1.1066868401e-49
C189	y^{18}	-3.8275089169e-41	-7.5049710077e-51
C191	$x^{18} y$	-6.6231305715e-49	3.5010571058e-54
C193	$x^{16} y^3$	-1.9531652351e-47	3.0239376636e-53
C195	$x^{14} y^5$	-1.5596286432e-46	9.6000865790e-53
C197	$x^{12} y^7$	-2.7612826568e-46	1.4288997592e-52
C199	$x^{10} y^9$	2.2685749027e-45	4.3837168676e-53
C201	$x^8 y^{11}$	1.1060475171e-44	-1.3861103840e-52
C203	$x^6 y^{13}$	2.2481184782e-44	-1.9505856121e-52
C205	$x^4 y^{15}$	-5.5736348440e-44	-1.2876676644e-52
C207	$x^2 y^{17}$	-2.3355064681e-43	-5.4584052762e-53
C209	y^{19}	2.4999420572e-43	-9.9807676723e-54
C210	x^{20}	-1.0353720807e-52	1.9354967630e-57
C212	$x^{18} y^2$	-5.6366301161e-51	3.9549546692e-56

C214	$x^{16}y^4$	-8.1535236564e-50	3.0235091280e-55
C216	$x^{14}y^6$	-4.6753079245e-49	1.2341447797e-54
C218	$x^{12}y^8$	-1.4492509936e-48	2.9999942233e-54
C220	$x^{10}y^{10}$	-6.7059393099e-48	4.6089255426e-54
C222	x^8y^{12}	-4.9436079305e-47	4.5137492751e-54
C224	x^6y^{14}	-1.2111220000e-46	2.7875737733e-54
C226	x^4y^{16}	-3.4078403898e-46	1.0119870942e-54
C228	x^2y^{18}	1.1009407304e-45	1.6135052322e-55
C230	y^{20}	-5.8411328388e-46	9.4380058569e-57
C232	$x^{20}y$	1.5055586184e-54	-2.2462277192e-60
C234	$x^{18}y^3$	5.2410832904e-53	-2.2707851790e-59
C236	$x^{16}y^5$	5.5851300777e-52	-8.9192926369e-59
C238	$x^{14}y^7$	2.2374347879e-51	-1.8389741887e-58
C240	$x^{12}y^9$	7.1591347845e-52	-1.7044880131e-58
C242	$x^{10}y^{11}$	-3.9294714180e-50	2.9056131275e-59
C244	x^8y^{13}	-8.1423894706e-50	2.2670392369e-58
C246	x^6y^{15}	-2.3729390056e-49	2.3590501620e-58
C248	x^4y^{17}	1.3995947959e-48	1.3535441041e-58
C250	x^2y^{19}	-1.5620953183e-48	4.9658777142e-59
C252	y^{21}	7.0891533326e-49	8.3944169943e-60
C253	x^{22}	2.2336861363e-58	-1.3577467667e-63
C255	$x^{20}y^2$	1.6766401731e-56	-2.6517938952e-62
C257	$x^{18}y^4$	3.1385425719e-55	-2.1019901027e-61
C259	$x^{16}y^6$	2.3730923666e-54	-9.3254487977e-61
C261	$x^{14}y^8$	9.8135101820e-54	-2.5667161093e-60
C263	$x^{12}y^{10}$	1.7231582939e-53	-4.6597300134e-60
C265	$x^{10}y^{12}$	1.1075385549e-52	-5.6882278778e-60
C267	x^8y^{14}	3.7804650231e-52	-4.6360430455e-60
C269	x^6y^{16}	1.1279204591e-51	-2.4726486765e-60
C271	x^4y^{18}	-1.3479781662e-51	-7.9647092611e-61
C273	x^2y^{20}	4.9488344281e-52	-1.2052423513e-61
C275	y^{22}	-4.2347282476e-52	-7.0219628579e-63

用於圖2的表3c

【0066】該光闌邊緣之座標

x_i [mm]	y_i [mm]	$x_{i+N/2}$ [mm]	$y_{i+N/2}$ [mm]
-400.659323	-53.864111	401.077124	-67.204113
-400.020726	-47.147576	400.855494	-73.819131
-399.097003	-40.405795	400.347077	-80.392036
-397.889740	-33.643190	399.552636	-86.918876
-396.400971	-26.864237	398.473403	-93.395828
-394.633175	-20.073447	397.111064	-99.819197
-392.589253	-13.275354	395.467753	-106.185427

-390.272521	-6.474497	393.546032	-112.491097
-387.686685	0.324586	391.348878	-118.732928
-384.835826	7.117377	388.879660	-124.907779
-381.724381	13.899380	386.142117	-131.012647
-378.357118	20.666132	383.140338	-137.044665
-374.739116	27.413207	379.878732	-143.001100
-370.875745	34.136218	376.362006	-148.879345
-366.772636	40.830822	372.595134	-154.676917
-362.435665	47.492719	368.583332	-160.391451
-357.870923	54.117650	364.332027	-166.020693
-353.084692	60.701401	359.846834	-171.562494
-348.083427	67.239799	355.133522	-177.014801
-342.873723	73.728710	350.197994	-182.375652
-337.462298	80.164036	345.046255	-187.643166
-331.855962	86.541711	339.684392	-192.815537
-326.061598	92.857696	334.118551	-197.891028
-320.086139	99.107972	328.354912	-202.867963
-313.936538	105.288533	322.399672	-207.744722
-307.619750	111.395377	316.259031	-212.519734
-301.142709	117.424499	309.939169	-217.191475
-294.512306	123.371878	303.446237	-221.758461
-287.735365	129.233469	296.786345	-226.219248
-280.818629	135.005193	289.965551	-230.572424
-273.768736	140.682927	282.989848	-234.816611
-266.592206	146.262492	275.865164	-238.950459
-259.295424	151.739651	268.597347	-242.972649
-251.884623	157.110096	261.192165	-246.881888
-244.365878	162.369444	253.655301	-250.676907
-236.745087	167.513236	245.992345	-254.356465
-229.027968	172.536938	238.208795	-257.919345
-221.220046	177.435936	230.310053	-261.364353
-213.326649	182.205550	222.301423	-264.690323
-205.352905	186.841040	214.188110	-267.896111
-197.303733	191.337614	205.975220	-270.980600
-189.183848	195.690444	197.667759	-273.942700
-180.997757	199.894686	189.270634	-276.781349
-172.749762	203.945488	180.788652	-279.495514
-164.443964	207.838015	172.226528	-282.084191
-156.084273	211.567461	163.588879	-284.546410
-147.674408	215.129069	154.880232	-286.881236
-139.217914	218.518141	146.105027	-289.087767
-130.718173	221.730059	137.267617	-291.165143
-122.178413	224.760293	128.372278	-293.112542

-113.601729	227.604421	119.423207	-294.929182
-104.991095	230.258144	110.424533	-296.614329
-96.349379	232.717300	101.380316	-298.167293
-87.679364	234.977891	92.294559	-299.587430
-78.983763	237.036106	83.171207	-300.874150
-70.265227	238.888348	74.014156	-302.026909
-61.526369	240.531266	64.827259	-303.045219
-52.769767	241.961788	55.614329	-303.928646
-43.997978	243.177159	46.379144	-304.676811
-35.213545	244.174974	37.125458	-305.289389
-26.419003	244.953213	27.856997	-305.766115
-17.616879	245.510269	18.577472	-306.106783
-8.809703	245.844975	9.290577	-306.311243
0.000000	245.956623	0.000000	-306.379407
8.809703	245.844975	-9.290577	-306.311243
17.616879	245.510269	-18.577472	-306.106783
26.419003	244.953213	-27.856997	-305.766115
35.213545	244.174974	-37.125458	-305.289389
43.997978	243.177159	-46.379144	-304.676811
52.769767	241.961788	-55.614329	-303.928646
61.526369	240.531266	-64.827259	-303.045219
70.265227	238.888348	-74.014156	-302.026909
78.983763	237.036106	-83.171207	-300.874150
87.679364	234.977891	-92.294559	-299.587430
96.349379	232.717300	-101.380316	-298.167293
104.991095	230.258144	-110.424533	-296.614329
113.601729	227.604421	-119.423207	-294.929182
122.178413	224.760293	-128.372278	-293.112542
130.718173	221.730059	-137.267617	-291.165143
139.217914	218.518141	-146.105027	-289.087767
147.674408	215.129069	-154.880232	-286.881236
156.084273	211.567461	-163.588879	-284.546410
164.443964	207.838015	-172.226528	-282.084191
172.749762	203.945488	-180.788652	-279.495514
180.997757	199.894686	-189.270634	-276.781349
189.183848	195.690444	-197.667759	-273.942700
197.303733	191.337614	-205.975220	-270.980600
205.352905	186.841040	-214.188110	-267.896111
213.326649	182.205550	-222.301423	-264.690323
221.220046	177.435936	-230.310053	-261.364353
229.027968	172.536938	-238.208795	-257.919345
236.745087	167.513236	-245.992345	-254.356465
244.365878	162.369444	-253.655301	-250.676907

251.884623	157.110096	-261.192165	-246.881888
259.295424	151.739651	-268.597347	-242.972649
266.592206	146.262492	-275.865164	-238.950459
273.768736	140.682927	-282.989848	-234.816611
280.818629	135.005193	-289.965551	-230.572424
287.735365	129.233469	-296.786345	-226.219248
294.512306	123.371878	-303.446237	-221.758461
301.142709	117.424499	-309.939169	-217.191475
307.619750	111.395377	-316.259031	-212.519734
313.936538	105.288533	-322.399672	-207.744722
320.086139	99.107972	-328.354912	-202.867963
326.061598	92.857696	-334.118551	-197.891028
331.855962	86.541711	-339.684392	-192.815537
337.462298	80.164036	-345.046255	-187.643166
342.873723	73.728710	-350.197994	-182.375652
348.083427	67.239799	-355.133522	-177.014801
353.084692	60.701401	-359.846834	-171.562494
357.870923	54.117650	-364.332027	-166.020693
362.435665	47.492719	-368.583332	-160.391451
366.772636	40.830822	-372.595134	-154.676917
370.875745	34.136218	-376.362006	-148.879345
374.739116	27.413207	-379.878732	-143.001100
378.357118	20.666132	-383.140338	-137.044665
381.724381	13.899380	-386.142117	-131.012647
384.835826	7.117377	-388.879660	-124.907779
387.686685	0.324586	-391.348878	-118.732928
390.272521	-6.474497	-393.546032	-112.491097
392.589253	-13.275354	-395.467753	-106.185427
394.633175	-20.073447	-397.111064	-99.819197
396.400971	-26.864237	-398.473403	-93.395828
397.889740	-33.643190	-399.552636	-86.918876
399.097003	-40.405795	-400.347077	-80.392036
400.020726	-47.147576	-400.855494	-73.819131
400.659323	-53.864111	-401.077124	-67.204113
401.011674	-60.551047	-401.011674	-60.551047

用於圖2的表4

【0067】 該等反射鏡M1、M3、M4、M5、和M8對於該半徑具有負值，即原則上係凹面鏡。該等反射鏡M2、M6、和M7對於該半徑具有正值，即原則上係凸面鏡。依據圖2的該投影光學單元之該等反射鏡M1至M8在每種情況下皆沒有具不同記號的 R_x 、 R_y 半徑值。因此，該等反射鏡M1至M8原則上皆沒有鞍形。

第 22 頁，共 60 頁(發明說明書)

【0068】該光闌之光闌表面之邊界（也參見用於圖2的表4）從照明光3（其在該影像側上在具完整影像側遠心孔徑的該光闌表面之該方向上的該場中心點處傳播）之所有光線之該光闌表面上的相交點顯現。當該光闌係體現為孔徑光闌時，該邊界係內邊界。

【0069】該光闌AS可位於平面中或者具有三維具體實施例。該光闌AS之該範圍係可在該掃描方向（y）上比在該交叉掃描方向（x）上小。

【0070】投影光學單元7之更多資料出於以下的表5：

NA	數值孔徑	0.75
$ \beta_x $	該交叉掃描方向上的放大比例	4.0
$ \beta_y $	該掃描方向上的放大比例	8.0
RMS	掃描波前偏差（deviation）	9.7 mλ
N	反射鏡之數量	8

用於圖2的表5

【0071】投影光學單元7在分隔平面31a與影像場8之中心之間具有物件/影像偏移a。物件場4之中心係位於分隔平面31a中。分隔平面31a平行於該xz平面延伸。分隔平面31a係垂直於成像光學單元7之該yz經向平面。該物件/影像偏移a在投影光學單元7之該情況下為1650 mm。

【0072】該反射鏡M4之該所使用反射面係最靠近物件平面5的相鄰面。因此，該反射鏡M4之該所使用反射面定義該反射鏡M4之此所使用反射面與物件平面5之間的作業距離b。最靠近物件平面5的相鄰面的該反射鏡M4之反射部位係視為在該作業距離b之該定義之該範疇內。該作業距離b在投影光學單元7之該情況下為275 mm。

【0073】經向橫向尺寸c係定義在分隔平面31a與該等反射鏡之一（在這種情況下又再次係與前述分隔平面相距最遠的該反射鏡M4）之反射部位之間。該經向橫向尺寸c在投影光學單元7之該情況下為2154 mm。

【0074】 尺寸比率a/c在投影光學單元7之該情況下為0.76。尺寸比率b/c在投影光學單元7之該情況下為0.128。

【0075】 投影光學單元7係設計用於13.5 nm之照明光3之波長。

【0076】 該平均波前像差RMS（掃描波前偏差）係用於投影光學單元7之該成像品質的措施。

【0077】 投影光學單元7在該影像側上為至少大致遠心。

【0078】 圖3顯示可在投影曝光設備1（而非投影光學單元7）中使用的投影光學單元或成像光學單元31之又一具體實施例。對應於以上參照圖1至圖2已解說者的部件和功能具有相同元件符號，並係將不再詳細討論。

【0079】 投影光學單元31具有0.75之影像側數值孔徑。

【0080】 投影光學單元31具有總共十一個反射鏡M1至M11。該等反射鏡M1、M10、和M11係體現為用於正向入射的反射鏡。該等反射鏡M2至M9係體現為用於照明光3之掠入射的反射鏡。投影光學單元31具有用於掠入射的確切八個反射鏡。

【0081】 該等反射鏡M2至M8（即投影光學單元31之該等八個GI反射鏡之七個）反射成像光3使得：該等個別光線29在該等各自反射鏡M2至M8處之該等反射角相加，即導致其該偏轉效應之放大。該後續GI反射鏡M9係所謂的反向（counter）反射鏡並反射成像光3，使得這產生抵抗該等反射鏡M2至M8之該偏轉效應所導向的偏轉效應，亦即這對該等GI反射鏡M2至M8之該偏轉效應具有減法效應。依據對於有關DE 10 2019 219 209 A1中該投影光學單元的該等解說之該上下文中所明確說明的該等反射鏡之該等周圍效應的該等規則，投影光學單元31具有下列對於該等反射鏡M1至M11的偏轉效應之順序：RLLLLLLLRL。

【0082】 投影光學單元31在該物件側上為大致遠心。若該成像波束路徑係僅關於通過物件場4的該等個別光線列入考慮，則該入射光瞳係位於該xz平面中物件場4之下游4014.30 mm，以及該yz平面中物件場4之下游5750.64 mm。

【0083】 投影光學單元31在該等反射鏡M1與M2之間的該波束路徑中具有光瞳平面。中間影像平面係位於該反射鏡M5上的該反射區域中。又一光瞳平面係位於該成像光束路徑中該等反射鏡M5與M6之間。又一中間影像平面係位於該等反射鏡M6與M7之間。中間影像平面之該數量不同於依據圖3的該經向平面中的中間影像之該數量，不同於與其垂直的平面中的中間影像之該數量。在相互垂直平面中具中間影像之不同數量的此類投影光學單元，原則上係從WO 2016/166080 A1和DE 10 2015 226 531 A1已知。

【0084】 用於投影光學單元31的該光學設計資料從下列表1至表5顯現，這進而在該基本結構方面對應於與依據圖2的該具體實施例相關的表1至表5。

【0085】 該等表面之半徑

	Radius_x [mm]	Power_x [1/mm]	Radius_y [mm]	Power_y [1/mm]
M01	-5029.13719149	0.00038797	-2041.19092644	0.00095589
M02	-27726.18088887	0.00001519	8806.64410475	-0.00004783
M03	-7556.63410985	0.00004602	11889.31888391	-0.00002925
M04	-4613.40209240	0.00004549	-13969.68056904	0.00001502
M05	-1484.95099271	0.00028553	-4659.68392717	0.00009099
M06	-1013.23301051	0.00055220	-1851.21517662	0.00030224
M07	-2311.26230546	0.00015940	-6624.51684518	0.00005561
M08	5271.95258536	-0.00009301	-4363.23285760	0.00011238
M09	-4641.10272093	0.00014769	2064.14241825	-0.00033206
M10	12237.81918069	-0.00014301	387.34284857	-0.00451843
M11	-944.21286884	0.00207223	-782.41102810	0.00250077

用於圖3的表1

【0086】 偏心（位置、角度）該等表面

	D_x [mm]	D_y [mm]	D_z [mm]
Reticle	0.000000000	0.000000000	0.000000000
M01	0.000000000	208.167034845	2161.897315865
M02	0.000000000	586.474040464	1067.521292230
M03	0.000000000	1137.007761372	664.081569966
M04	0.000000000	1899.293204386	345.745645359
M05	0.000000000	2431.941388346	286.993274957
M06	0.000000000	2984.723951303	449.275081298
M07	0.000000000	3296.138682846	751.383932581
M08	0.000000000	3380.101736953	1042.029180798
M09	0.000000000	3346.308156022	1257.846377059
M10	0.000000000	3703.559415463	2183.653612397

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Stop	0.000000000	3668.591404244	2093.043669197
M11	-0.000000000	3468.490281216	1574.536875135
Wafer	0.000000000	3468.489856034	2300.002089582

	$\alpha_x [^\circ]$	$\alpha_y [^\circ]$	$\alpha_z [^\circ]$
Reticle	0.000000000	0.000000000	0.000000000
M01	6.784694572	0.000000000	0.000000000
M02	-53.582577637	180.000000000	0.000000000
M03	150.549843408	0.000000000	0.000000000
M04	-14.480092757	180.000000000	0.000000000
M05	185.033188037	0.000000000	0.000000000
M06	30.245900660	180.000000000	0.000000000
M07	239.008897816	0.000000000	0.000000000
M08	86.393070938	180.000000000	0.000000000
M09	83.899354742	0.000000000	0.000000000
M10	-21.101573082	0.000000000	180.000000000
Stop	158.897499094	-0.000000000	-0.000000000
M11	169.448766337	-0.000000000	0.000000000
Wafer	0.000033580	0.000000000	180.000000000

用於圖3的表2

【0087】該等表面之自由形式係數

係數	公式	M01	M02	M03
C7	$x^2 y$	-3.4202758877e-09	-8.1600037120e-09	5.4784066641e-08
C9	y^3	-5.1579184037e-09	2.1490169585e-08	-1.5630842115e-09
C10	x^4	-4.1758180942e-12	1.2422725986e-10	4.6214862684e-11
C12	$x^2 y^2$	8.9525383746e-11	-1.4680359565e-10	8.9494220059e-12
C14	y^4	-1.9101171293e-11	-6.1013326570e-11	-7.5850147156e-12
C16	$x^4 y$	-7.6462012646e-14	-7.6908929058e-14	-8.1912635689e-14
C18	$x^2 y^3$	-6.5595088710e-14	-2.0612905257e-13	-7.1202800735e-14
C20	y^5	1.2668389322e-14	2.2496666963e-14	-2.1530045613e-14
C21	x^6	1.2260375804e-17	-3.7706929577e-17	-1.7860995077e-16
C23	$x^4 y^2$	-4.1462206300e-17	-2.2047103244e-16	-5.3142812534e-18
C25	$x^2 y^4$	-7.0178347129e-17	3.0190842210e-16	-1.7452167445e-17
C27	y^6	2.0724751930e-16	-3.5162036726e-16	6.4973339128e-17
C29	$x^6 y$	7.8478607545e-21	-3.1708007154e-19	-9.4569358091e-20
C31	$x^4 y^3$	1.3490030999e-19	-2.2975637164e-19	1.2181039714e-19
C33	$x^2 y^5$	-5.0152079339e-19	-5.4350876110e-19	2.8563131654e-19
C35	y^7	-3.8866394119e-20	-1.4335882567e-18	-1.1086359243e-19
C36	x^8	-2.3339394362e-23	3.9460690291e-22	2.9888564272e-22
C38	$x^6 y^2$	-4.6819160973e-22	-1.1206066225e-21	-9.7865526917e-23
C40	$x^4 y^4$	1.1130713726e-21	1.2800571912e-21	5.2638737050e-22

C42	x^2y^6	3.2076089447e-22	2.8639063623e-22	-2.2596620483e-22
C44	y^8	-1.0798131013e-20	-3.0974451336e-21	1.9329485313e-22
C46	x^8y	-6.9989769761e-26	2.6157691458e-25	-4.5285068583e-26
C48	x^6y^3	-3.3827276208e-24	1.7863426636e-23	-1.0020151492e-25
C50	x^4y^5	-9.4812740396e-24	3.7955502533e-23	-2.9298995798e-24
C52	x^2y^7	-2.7828827712e-23	1.2071534933e-23	4.1481525917e-25
C54	y^9	-6.8502586063e-23	-1.6956263975e-23	3.3338978089e-25
C55	x^{10}	6.6696912458e-28	-2.6405295227e-28	2.7329539874e-28
C57	x^8y^2	1.0556854319e-26	4.3604788107e-26	-5.0740682280e-27
C59	x^6y^4	2.1155006429e-26	9.5793848687e-27	-6.6690755906e-27
C61	x^4y^6	2.0187788389e-26	-9.8410632955e-26	-2.8311274084e-27
C63	x^2y^8	3.0429078041e-25	-6.3994145022e-26	-5.2202669243e-27
C65	y^{10}	9.6372881505e-25	-2.7422225856e-26	-1.4694335966e-28
C67	$x^{10}y$	5.7298330391e-30	3.8383874583e-30	-6.7470749425e-30
C69	x^8y^3	7.8002410402e-29	-3.3050157101e-28	9.9965761479e-31
C71	x^6y^5	3.0940331786e-28	-1.2448438857e-27	4.0730523721e-29
C73	x^4y^7	9.5849050883e-28	-1.5283972886e-27	3.5766281424e-29
C75	x^2y^9	2.5829707531e-27	-1.5562757806e-28	-1.4839218380e-29
C77	y^{11}	4.2694397257e-27	1.2836577395e-28	-8.6704298814e-30
C78	x^{12}	-1.0815329562e-32	6.2375129788e-33	-1.5532155562e-32
C80	$x^{10}y^2$	-1.8038497824e-31	-6.8732193665e-31	6.9039084772e-32
C82	x^8y^4	-6.8022364927e-31	-9.2726253758e-31	8.5642898328e-32
C84	x^6y^6	-7.8249269991e-31	1.7400864771e-30	9.4364791826e-32
C86	x^4y^8	-4.1186609772e-30	1.8001202540e-30	9.8409615071e-32
C88	x^2y^{10}	-2.7257517404e-29	9.2486125841e-31	1.0786036596e-31
C90	y^{12}	-5.1669319257e-29	3.8596938474e-31	-2.2018919852e-32
C92	$x^{12}y$	-9.5983493172e-35	-2.1755264785e-34	9.9526007449e-35
C94	$x^{10}y^3$	-1.2917940667e-33	3.6182279937e-33	7.1354156561e-35
C96	x^8y^5	-6.1118822034e-33	2.1159798424e-32	-4.4506711806e-34
C98	x^6y^7	-1.9673212417e-32	4.4692492346e-32	-9.4608090853e-34
C100	x^4y^9	-5.1891177511e-32	3.0421749148e-32	-3.0711170516e-34
C102	x^2y^{11}	-1.1466469103e-31	-9.9633641271e-34	1.3166576085e-34
C104	y^{13}	-1.5994476367e-31	1.0277888248e-33	1.3551050694e-34
C105	x^{14}	1.0112202758e-37	-1.8527612914e-37	5.3021648224e-38
C107	$x^{12}y^2$	1.8787266933e-36	5.5463175543e-36	-3.8144935781e-37
C109	$x^{10}y^4$	9.8564738206e-36	1.6775742718e-35	-6.2453338969e-37
C111	x^8y^6	1.7387768869e-35	1.2974801606e-36	-1.2224300883e-36
C113	x^6y^8	2.2681834289e-35	-1.9550260786e-35	-1.7363713191e-36
C115	x^4y^{10}	2.9232046658e-34	1.3780032690e-35	-1.7319269098e-36
C117	x^2y^{12}	1.2535038132e-33	-1.0820146117e-35	-9.4133121050e-37
C119	y^{14}	1.7090202975e-33	4.8809008248e-36	3.5120584817e-37
C121	$x^{14}y$	8.6607058835e-40	2.4631327352e-39	-7.6131713896e-40
C123	$x^{12}y^3$	1.3690225517e-38	-2.2045573691e-38	-9.1041031300e-40

C125	$x^{10}y^5$	7.9232753449e-38	-1.8619928426e-37	2.7674106762e-39
C127	x^8y^7	2.6468607327e-37	-5.9742954156e-37	9.4839191489e-39
C129	x^6y^9	7.3576520674e-37	-7.4089726699e-37	8.7492367472e-39
C131	x^4y^{11}	1.5469045233e-36	-2.4113906098e-37	1.3997827257e-39
C133	x^2y^{13}	2.8746396170e-36	5.9495633408e-38	-5.8277668773e-40
C135	y^{15}	3.6922119781e-36	-4.0498264808e-40	-1.6251636506e-39
C136	x^{16}	-5.5486018344e-43	1.7656066281e-42	-1.3428781540e-43
C138	$x^{14}y^2$	-1.2161472088e-41	-2.4742736927e-41	6.3530910992e-43
C140	$x^{12}y^4$	-7.9117744888e-41	-1.3645594080e-40	2.0656914423e-42
C142	$x^{10}y^6$	-1.9220472871e-40	-2.7799880496e-40	8.8423178242e-42
C144	x^8y^8	-1.1779242046e-41	-3.0306580962e-40	1.8019533718e-41
C146	x^6y^{10}	-9.0866868569e-40	-5.0812759188e-40	1.9291665800e-41
C148	x^4y^{12}	-1.0589597504e-38	-4.4330942359e-40	1.4669895704e-41
C150	x^2y^{14}	-3.2620542390e-38	2.9034466223e-40	3.4773500168e-42
C152	y^{16}	-3.4845417046e-38	-3.0516896497e-41	-1.2632621610e-42
C154	$x^{16}y$	-4.5336234429e-45	-1.1010178086e-44	2.7966309948e-45
C156	$x^{14}y^3$	-8.5714177986e-44	6.9195881040e-44	4.3617177756e-45
C158	$x^{12}y^5$	-6.2123659373e-43	8.0533327253e-43	-8.6267187632e-45
C160	$x^{10}y^7$	-2.3563367843e-42	3.6191538565e-42	-4.4829374364e-44
C162	x^8y^9	-6.4739515198e-42	6.9947907903e-42	-6.1600312437e-44
C164	x^6y^{11}	-1.4524006496e-41	4.8026591296e-42	-3.8331079573e-44
C166	x^4y^{13}	-2.4735749000e-41	6.8148847652e-44	-3.9563424202e-45
C168	x^2y^{15}	-3.9202438764e-41	2.2919776746e-44	3.7842451927e-45
C170	y^{17}	-5.1112095432e-41	6.6119189328e-45	8.7556239722e-45
C171	x^{18}	1.7669849485e-48	-7.2146170920e-48	5.1798517293e-49
C173	$x^{16}y^2$	4.8297044297e-47	5.6890921630e-47	1.7875826058e-48
C175	$x^{14}y^4$	3.6511808040e-46	5.3293682901e-46	-1.0904221176e-48
C177	$x^{12}y^6$	1.0286013254e-45	2.2175725023e-45	-3.5370413683e-47
C179	$x^{10}y^8$	-8.7120936294e-46	5.5970769928e-45	-9.1856508583e-47
C181	x^8y^{10}	-7.6651593072e-45	8.1112830545e-45	-1.3051093760e-46
C183	x^6y^{12}	2.4821376776e-44	7.9703062027e-45	-9.7163956148e-47
C185	x^4y^{14}	1.9932411848e-43	1.3787666777e-45	-5.7163004196e-47
C187	x^2y^{16}	4.7170265650e-43	-1.7135949133e-45	-7.4449434738e-48
C189	y^{18}	4.1692610245e-43	-1.8709479508e-47	-1.1767681798e-48
C191	$x^{18}y$	1.2852059732e-50	1.7560896234e-50	-3.9559581786e-51
C193	$x^{16}y^3$	2.8859754502e-49	-8.7434968324e-50	-7.5693511098e-51
C195	$x^{14}y^5$	2.5919190405e-48	-1.3609856365e-48	9.8319371871e-51
C197	$x^{12}y^7$	1.2030540733e-47	-8.0301641939e-48	8.3120587374e-50
C199	$x^{10}y^9$	3.4034259220e-47	-2.2201643867e-47	1.4180259218e-49
C201	x^8y^{11}	7.6238889168e-47	-2.5937836818e-47	1.4759315303e-49
C203	x^6y^{13}	1.2498776681e-46	-6.6048202518e-49	5.8694529977e-50
C205	x^4y^{15}	1.8726146173e-46	3.4967691792e-48	5.8439380908e-51
C207	x^2y^{17}	2.2780198354e-46	-3.4542661685e-48	-1.4032340153e-50

C209	y^{19}	3.8268070940e-46	-6.0527384080e-49	-2.0496980344e-50
C210	x^{20}	-2.9855603339e-54	1.0850672687e-53	-9.6871922544e-55
C212	$x^{18}y^2$	-1.0945118595e-52	-5.1497169543e-53	-5.9147787514e-54
C214	$x^{16}y^4$	-9.2381864771e-52	-8.1009277926e-52	-6.2617513042e-54
C216	$x^{14}y^6$	-2.4283073940e-51	-5.2651139388e-51	5.8630217526e-53
C218	$x^{12}y^8$	7.9238933105e-51	-2.0248989147e-50	1.8815802979e-52
C220	$x^{10}y^{10}$	7.8047594751e-50	-4.1988819787e-50	3.2717085342e-52
C222	x^8y^{12}	1.5303226803e-49	-4.0289755825e-50	3.0713582657e-52
C224	x^6y^{14}	-2.4775377926e-49	-3.8115226043e-51	1.9326644766e-52
C226	x^4y^{16}	-1.7866765799e-48	3.3039287502e-51	8.3147949596e-53
C228	x^2y^{18}	-3.2563244015e-48	-2.3082978925e-51	1.7438668546e-53
C230	y^{20}	-2.5650942280e-48	-8.4346353683e-52	1.7165717085e-53
C232	$x^{20}y$	-1.5194339584e-56	0.0000000000e+00	0.0000000000e+00
C234	$x^{18}y^3$	-4.0106786832e-55	0.0000000000e+00	0.0000000000e+00
C236	$x^{16}y^5$	-4.3687588631e-54	0.0000000000e+00	0.0000000000e+00
C238	$x^{14}y^7$	-2.5239118751e-53	0.0000000000e+00	0.0000000000e+00
C240	$x^{12}y^9$	-8.3121917452e-53	0.0000000000e+00	0.0000000000e+00
C242	$x^{10}y^{11}$	-1.7428695366e-52	0.0000000000e+00	0.0000000000e+00
C244	x^8y^{13}	-2.8874735960e-52	0.0000000000e+00	0.0000000000e+00
C246	x^6y^{15}	-1.9285524716e-52	0.0000000000e+00	0.0000000000e+00
C248	x^4y^{17}	-4.0627092527e-52	0.0000000000e+00	0.0000000000e+00
C250	x^2y^{19}	-2.0768493338e-52	0.0000000000e+00	0.0000000000e+00
C252	y^{21}	-1.0720720504e-51	0.0000000000e+00	0.0000000000e+00
C253	x^{22}	2.0049530546e-60	0.0000000000e+00	0.0000000000e+00
C255	$x^{20}y^2$	1.1026792133e-58	0.0000000000e+00	0.0000000000e+00
C257	$x^{18}y^4$	1.0194079423e-57	0.0000000000e+00	0.0000000000e+00
C259	$x^{16}y^6$	1.7346242654e-57	0.0000000000e+00	0.0000000000e+00
C261	$x^{14}y^8$	-2.2440134927e-56	0.0000000000e+00	0.0000000000e+00
C263	$x^{12}y^{10}$	-2.0611456096e-55	0.0000000000e+00	0.0000000000e+00
C265	$x^{10}y^{12}$	-7.8621089430e-55	0.0000000000e+00	0.0000000000e+00
C267	x^8y^{14}	-1.2244410209e-54	0.0000000000e+00	0.0000000000e+00
C269	x^6y^{16}	-6.2601755871e-56	0.0000000000e+00	0.0000000000e+00
C271	x^4y^{18}	5.3242810616e-54	0.0000000000e+00	0.0000000000e+00
C273	x^2y^{20}	6.8400181647e-54	0.0000000000e+00	0.0000000000e+00
C275	y^{22}	5.2392353627e-54	0.0000000000e+00	0.0000000000e+00

用於圖3的表3a

係數	公式	M04	M05	M06
C7	x^2y	-4.6919111689e-08	1.4018878183e-07	-1.0081701453e-07
C9	y^3	1.8253007125e-09	1.6162333960e-07	1.9138800628e-07
C10	x^4	-2.9018086007e-11	-8.0509590704e-11	2.3673364745e-11
C12	x^2y^2	8.6224557653e-12	-2.5834562977e-10	3.0758167147e-10

C14	y^4	-2.5035635214e-11	-7.3073930744e-11	3.8614580986e-10
C16	$x^4 y$	3.3058503631e-14	1.2456814683e-13	-1.2772621620e-13
C18	$x^2 y^3$	-3.1589484929e-14	6.1984215403e-14	-5.9980511134e-13
C20	y^5	-8.4642786270e-15	9.9374193893e-14	-4.2774786969e-13
C21	x^6	-1.4011649205e-16	1.7849602607e-17	5.5847475583e-17
C23	$x^4 y^2$	-2.3864781097e-17	-2.2833674225e-17	-4.4818417386e-16
C25	$x^2 y^4$	-4.9069998309e-17	-1.2182931067e-16	-5.0576058471e-15
C27	y^6	-7.4654199723e-17	1.5300111700e-16	-4.3607198339e-16
C29	$x^6 y$	-4.5265599843e-20	1.8519879406e-19	-1.0643353510e-21
C31	$x^4 y^3$	-4.7645527959e-20	-1.4009807520e-19	2.5643866829e-18
C33	$x^2 y^5$	-2.6788867244e-19	-1.7685405547e-18	7.0806431686e-19
C35	y^7	-9.4302989834e-20	-2.0295110973e-18	-3.4349156239e-17
C36	x^8	2.3391237217e-22	-2.0628266673e-22	2.6132020498e-22
C38	$x^6 y^2$	5.5883830568e-23	1.8001836611e-22	5.6368067461e-23
C40	$x^4 y^4$	-4.9876036676e-22	2.1710049686e-21	2.5279269330e-20
C42	$x^2 y^6$	-4.5163268276e-22	6.4382660405e-21	8.9508362182e-21
C44	y^8	5.8010238179e-23	1.4075101538e-19	-1.6321563225e-19
C46	$x^8 y$	-4.5695720559e-27	-4.0381404993e-25	-2.6617080446e-25
C48	$x^6 y^3$	-1.1212863322e-24	2.9094733892e-24	-1.8127742990e-23
C50	$x^4 y^5$	-1.5764003940e-24	1.4108337367e-23	-1.3469966836e-23
C52	$x^2 y^7$	1.1213109772e-24	-5.3421691468e-23	1.0748109606e-21
C54	y^9	1.1424273419e-25	2.6461372776e-22	8.5875633704e-21
C55	x^{10}	-6.5881676753e-28	-8.3724676404e-29	-8.0410002448e-28
C57	$x^8 y^2$	-8.5880987336e-28	-3.5307271777e-27	5.6485146159e-27
C59	$x^6 y^4$	-1.0093204545e-27	-2.3830739121e-26	-2.9443445622e-26
C61	$x^4 y^6$	1.0580830393e-27	-1.7544683616e-25	1.5070766750e-25
C63	$x^2 y^8$	-8.2506562947e-27	-2.5865101624e-24	9.8469051674e-24
C65	y^{10}	-1.3363245211e-26	-3.2230886817e-23	-3.1844554132e-24
C67	$x^{10} y$	1.1233617267e-30	3.1613661823e-30	8.6718383227e-30
C69	$x^8 y^3$	5.9646164696e-30	-2.1946077692e-29	2.1934062477e-28
C71	$x^6 y^5$	2.2722688419e-29	-1.9459888699e-28	1.0018954686e-27
C73	$x^4 y^7$	-3.2249553976e-29	1.4535959356e-27	-1.3266066652e-26
C75	$x^2 y^9$	-1.2191696803e-28	2.5705533412e-26	-2.4262538931e-25
C77	y^{11}	-2.8964082528e-29	1.1613866353e-25	-1.5738840092e-24
C78	x^{12}	4.9267991596e-33	5.2985481711e-33	-1.1936992974e-32
C80	$x^{10} y^2$	7.3327143242e-33	1.2644776661e-32	-1.2121388095e-31
C82	$x^8 y^4$	1.2733141708e-32	3.4066396679e-31	-1.3294947998e-30
C84	$x^6 y^6$	-8.3754850051e-32	3.0003234925e-30	-5.1000348453e-30
C86	$x^4 y^8$	-2.3254781021e-31	1.6826769210e-29	-1.5530788550e-28
C88	$x^2 y^{10}$	-8.5598460559e-32	2.7420100914e-28	-6.8256227284e-28
C90	y^{12}	2.2180850522e-31	3.4186134167e-27	6.3322543085e-27
C92	$x^{12} y$	-2.7433514556e-36	-1.1289288324e-35	-9.6724426897e-35
C94	$x^{10} y^3$	-4.7586957087e-35	4.6702203629e-36	-2.5712999447e-33

C96	$x^8 y^5$	-4.7545047276e-34	9.6780603671e-34	-2.0510233332e-32
C98	$x^6 y^7$	-8.2297728621e-34	-8.5557064896e-33	2.8607943365e-32
C100	$x^4 y^9$	4.9628734493e-34	-4.2841778018e-31	3.3578661634e-30
C102	$x^2 y^{11}$	2.2276901854e-33	-4.3443105975e-30	2.8261396982e-29
C104	y^{13}	5.8351464578e-34	-2.7948744240e-29	1.7711923002e-28
C105	x^{14}	-5.4354353797e-38	-2.2248119285e-38	1.8008278590e-37
C107	$x^{12} y^2$	-7.6887074368e-38	6.3742721923e-38	1.2854029898e-36
C109	$x^{10} y^4$	-4.7495801026e-37	-2.1522493974e-36	1.9110302655e-35
C111	$x^8 y^6$	-1.1773512840e-36	-3.4881187811e-35	1.2096714307e-34
C113	$x^6 y^8$	5.0085939154e-37	-7.0448057868e-36	7.5048317624e-34
C115	$x^4 y^{10}$	4.4579790243e-36	1.0807498528e-33	1.4730895606e-32
C117	$x^2 y^{12}$	4.6198184857e-36	-4.2727964578e-33	-5.5510623066e-32
C119	y^{14}	-2.9478321574e-36	-9.7310287771e-32	-9.1866898396e-31
C121	$x^{14} y$	-3.4915632053e-41	1.1915690881e-41	2.4122261565e-40
C123	$x^{12} y^3$	-1.3817996143e-40	5.5606169611e-40	1.7838267949e-38
C125	$x^{10} y^5$	1.5817215627e-39	4.0195460200e-40	1.9768338165e-37
C127	$x^8 y^7$	7.4306198543e-39	1.1150266905e-37	6.6911250425e-37
C129	$x^6 y^9$	9.1132401735e-39	4.1617307677e-37	-1.8357811456e-35
C131	$x^4 y^{11}$	-5.3117409780e-39	3.5018938464e-35	-3.5007085798e-34
C133	$x^2 y^{13}$	-2.2828974265e-38	2.9750511034e-34	-1.7038138998e-33
C135	y^{15}	-9.6733588226e-39	1.8978248618e-33	-1.2293938704e-32
C136	x^{16}	2.6379321173e-43	6.3250853595e-44	-1.2555048692e-42
C138	$x^{14} y^2$	1.6805055477e-43	-7.4919150820e-43	-8.3354498754e-42
C140	$x^{12} y^4$	2.1967077774e-42	7.5605897278e-42	-1.2424315115e-40
C142	$x^{10} y^6$	1.2870344320e-41	1.7703211793e-40	-1.4252448957e-39
C144	$x^8 y^8$	2.6977135786e-41	4.5454498284e-40	-8.8208994212e-40
C146	$x^6 y^{10}$	-8.1514424788e-42	-8.2260761041e-39	-5.9937093928e-38
C148	$x^4 y^{12}$	-6.4506268489e-41	-2.7696063219e-37	-6.5630931197e-38
C150	$x^2 y^{14}$	-9.4392874214e-41	-1.0652214502e-36	9.1537402933e-36
C152	y^{16}	1.7310147389e-41	-5.6776251107e-36	6.6554991728e-35
C154	$x^{16} y$	1.5317573206e-46	1.1388225260e-46	4.1747621637e-46
C156	$x^{14} y^3$	1.5654653359e-45	-2.4857140337e-45	-6.5877876391e-44
C158	$x^{12} y^5$	1.7895619193e-45	-3.7797363365e-44	-9.1835194349e-43
C160	$x^{10} y^7$	-3.7082487176e-45	-6.8971109455e-43	-6.0401689567e-42
C162	$x^8 y^9$	-3.9193297983e-44	-4.4179811943e-43	3.7818838134e-41
C164	$x^6 y^{11}$	-9.5469919734e-44	-2.3488210996e-41	1.5348371315e-39
C166	$x^4 y^{13}$	-7.8995363375e-44	3.8004152927e-40	1.7047290765e-38
C168	$x^2 y^{15}$	-9.2629257347e-45	-7.7657728219e-39	4.0970986264e-38
C170	y^{17}	8.2836171309e-44	-1.4302437709e-38	5.0382527675e-37
C171	x^{18}	-6.5333379241e-49	-1.5057794552e-49	4.6695457651e-48
C173	$x^{16} y^2$	2.8610407792e-49	2.3735934076e-48	2.8165961363e-47
C175	$x^{14} y^4$	-2.2515439953e-48	-1.2637688111e-47	3.7976221258e-46
C177	$x^{12} y^6$	-3.5665179513e-47	-2.4082341714e-46	7.5885599371e-45

C179	$x^{10}y^8$	-1.6171675339e-46	-4.2823378618e-45	7.1006408345e-45
C181	x^8y^{10}	-2.7085338757e-46	1.0300759912e-44	-4.9470914486e-44
C183	x^6y^{12}	-8.9359429915e-47	7.5345292637e-43	-6.5940980794e-43
C185	x^4y^{14}	1.5349329900e-46	2.0927494653e-42	-4.2938355971e-41
C187	x^2y^{16}	5.2740083554e-46	7.9802384763e-41	-3.6576710798e-40
C189	y^{18}	-1.5284540620e-47	8.4380122088e-41	-2.7338055320e-39
C191	$x^{18}y$	-1.9818000134e-52	-3.2843622423e-52	-2.1169359160e-51
C193	$x^{16}y^3$	-3.3835872471e-51	3.5822179769e-51	9.8837699806e-50
C195	$x^{14}y^5$	-1.5410213140e-50	1.8369624067e-49	1.6263584683e-48
C197	$x^{12}y^7$	-1.1107803516e-49	4.5568862779e-49	1.6049430266e-47
C199	$x^{10}y^9$	-3.7598742192e-49	6.0790621137e-47	-9.7389029292e-48
C201	x^8y^{11}	-3.3533356521e-49	-5.3991952333e-46	-1.9866472076e-45
C203	x^6y^{13}	9.1584589484e-50	-4.8080052063e-46	-4.5214833329e-44
C205	x^4y^{15}	4.3754203193e-49	-1.9158978765e-44	-2.7767309791e-43
C207	x^2y^{17}	1.0475851486e-48	-2.3241218793e-43	-2.2147383503e-44
C209	y^{19}	-3.3222240956e-49	-4.0090513637e-44	-9.6408290230e-42
C210	x^{20}	6.8127965305e-55	1.9083761220e-55	-7.1764184193e-54
C212	$x^{18}y^2$	-1.1809602416e-54	-2.2614079810e-54	-3.8228959993e-53
C214	$x^{16}y^4$	-5.3863242260e-54	-1.2322615781e-53	-4.2654388622e-52
C216	$x^{14}y^6$	-1.2198550115e-53	-4.6097235427e-52	-1.4592372296e-50
C218	$x^{12}y^8$	-1.1179524681e-52	4.7457648720e-51	-5.0579158593e-50
C220	$x^{10}y^{10}$	-2.4201087413e-52	-2.3876888406e-49	4.4129108488e-49
C222	x^8y^{12}	-1.0775957248e-52	2.9374564283e-48	4.6805439361e-48
C224	x^6y^{14}	1.1081530874e-52	-1.5595949465e-47	1.3592595635e-46
C226	x^4y^{16}	3.0684358801e-52	9.8555319140e-47	1.0988321855e-45
C228	x^2y^{18}	6.5432217197e-52	6.3071466742e-47	3.2572549929e-45
C230	y^{20}	-3.2748326320e-52	1.3699657116e-47	5.3682390236e-44

用於圖3的表3b

係數	公式	M07	M08	M09
C7	x^2y	-1.5406892486e-07	2.5063978769e-07	-1.2243983927e-07
C9	y^3	-1.0071762212e-07	1.4262511688e-07	-7.4016702454e-07
C10	x^4	-2.3927166450e-10	-2.5853745427e-10	2.8395839048e-10
C12	x^2y^2	8.5067776647e-10	5.9320079597e-11	-7.4988465420e-11
C14	y^4	1.3233325218e-09	-4.1315127363e-10	4.1975421828e-09
C16	x^4y	2.6529267257e-12	-4.4811570530e-13	1.0689692139e-12
C18	x^2y^3	2.0094726034e-12	2.0571717855e-12	-5.3369461863e-12
C20	y^5	-7.9535263077e-12	1.3128908941e-12	-2.4873922581e-11
C21	x^6	1.6623335881e-15	-9.1271948417e-16	4.8689237138e-15
C23	x^4y^2	-3.8345376618e-15	-4.1554050104e-15	1.1603086206e-14
C25	x^2y^4	-2.2422377702e-14	-3.2829460952e-15	2.1013928712e-14
C27	y^6	4.0650730479e-14	-6.2938426600e-15	1.7226074770e-13

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C29	$x^6 y$	-9.9690495446e-18	8.3186664273e-19	3.9662337450e-17
C31	$x^4 y^3$	-2.1403663732e-17	5.2223840938e-18	7.3273705623e-17
C33	$x^2 y^5$	1.3176929999e-16	1.6332539295e-17	-3.3811007209e-16
C35	y^7	-3.6873919625e-16	1.9527911956e-17	-1.0720301349e-15
C36	x^8	-8.9761469416e-21	5.1875659439e-20	-2.3693086180e-18
C38	$x^6 y^2$	3.5764406501e-20	3.9874086476e-20	-3.0131458776e-18
C40	$x^4 y^4$	2.8526231911e-19	1.3728349162e-19	-3.3736958430e-18
C42	$x^2 y^6$	-1.8071636856e-18	1.9751798121e-19	1.8208024498e-18
C44	y^8	4.1818723033e-18	2.1104661222e-19	5.5932805556e-18
C46	$x^8 y$	1.4226595790e-22	8.9349482182e-23	-4.1105713226e-20
C48	$x^6 y^3$	3.7591549180e-22	-9.5168566014e-22	-6.2514555514e-20
C50	$x^4 y^5$	-3.6713175415e-21	-7.2982775869e-22	-1.7050519553e-20
C52	$x^2 y^7$	2.8635316808e-20	2.3154495399e-21	1.0577409765e-20
C54	y^9	3.0734581915e-20	-1.8356921408e-21	-1.0864671545e-19
C55	x^{10}	2.2058209913e-25	-2.1116637697e-24	7.2691415848e-22
C57	$x^8 y^2$	-1.0285432994e-24	-2.6257643076e-24	1.3342198892e-21
C59	$x^6 y^4$	-1.5478136163e-23	-3.2933297424e-23	1.7092501943e-21
C61	$x^4 y^6$	1.3283605857e-22	-7.7319254943e-23	1.1230041000e-21
C63	$x^2 y^8$	3.1654945824e-22	-7.6300329054e-23	2.2059007667e-22
C65	y^{10}	-1.3353127768e-21	-2.7629081367e-23	2.1258842289e-21
C67	$x^{10} y$	-3.0463775887e-27	-2.0971761112e-26	2.1524607579e-23
C69	$x^8 y^3$	-2.4577680535e-26	7.9413968213e-26	3.8528388871e-23
C71	$x^6 y^5$	1.8898366600e-25	4.0514268238e-25	2.2328244433e-23
C73	$x^4 y^7$	6.9673799214e-25	-5.3032623185e-27	4.2868510876e-25
C75	$x^2 y^9$	-1.1663125856e-23	-1.6151153651e-25	-8.5072632820e-24
C77	y^{11}	8.6214064959e-25	3.0808600494e-25	6.2916892811e-24
C78	x^{12}	-4.7025762319e-30	6.1575537159e-29	-1.2728739819e-25
C80	$x^{10} y^2$	1.3800008981e-29	-3.7887849944e-28	-2.0854563910e-25
C82	$x^8 y^4$	8.9441902344e-28	2.4367045898e-27	-3.5498487783e-25
C84	$x^6 y^6$	-8.8731267067e-28	1.1370350226e-26	-4.4466835705e-25
C86	$x^4 y^8$	-7.5455085132e-26	1.4669472579e-26	-1.5780079565e-25
C88	$x^2 y^{10}$	5.6599295011e-26	9.1012727004e-27	-4.5298651109e-26
C90	y^{12}	2.8143256028e-25	1.1565142424e-27	-4.9433054127e-25
C92	$x^{12} y$	5.0778387731e-32	8.5828879377e-31	-5.1405105085e-27
C94	$x^{10} y^3$	1.2925431548e-30	-6.3856152579e-30	-1.2206542993e-26
C96	$x^8 y^5$	3.3878565135e-30	-4.2282672195e-29	-9.2319448493e-27
C98	$x^6 y^7$	-1.6901670373e-28	-5.4388646850e-29	-3.0106239902e-27
C100	$x^4 y^9$	2.6717388818e-28	1.2766417595e-29	2.9890289859e-28
C102	$x^2 y^{11}$	1.6096504879e-27	5.0503864774e-30	1.6116381504e-27
C104	y^{13}	-1.2780319808e-27	-1.9628127728e-29	-4.0934429528e-28
C105	x^{14}	7.4118809942e-35	-1.0677146298e-33	1.2659506744e-29
C107	$x^{12} y^2$	4.1227191307e-34	4.2914347971e-32	-5.8228987522e-30
C109	$x^{10} y^4$	-1.8651413337e-32	-7.0412925223e-32	-8.4754915086e-30

C111	$x^8 y^6$	-2.2912168412e-31	-8.8273686087e-31	5.7290310738e-29
C113	$x^6 y^8$	2.6032603416e-30	-1.5451079608e-30	5.6144395274e-29
C115	$x^4 y^{10}$	6.2420243755e-30	-1.4500934076e-30	8.7789085038e-30
C117	$x^2 y^{12}$	-2.0055873812e-29	-6.0445847896e-31	1.6579691844e-29
C119	y^{14}	-3.4858578548e-29	-3.9389786767e-32	9.6546892734e-29
C121	$x^{14} y$	-3.6349990515e-37	1.5867771987e-35	6.1704054854e-31
C123	$x^{12} y^3$	-2.6612139397e-35	5.1365759239e-34	1.8157455218e-30
C125	$x^{10} y^5$	-4.9008380781e-34	2.2276809261e-33	1.6925225667e-30
C127	$x^8 y^7$	5.3391634990e-33	4.9049682634e-33	8.4721409050e-31
C129	$x^6 y^9$	1.6152350742e-32	3.3959617450e-33	1.7588011963e-31
C131	$x^4 y^{11}$	-2.6638593784e-32	-1.2895012271e-33	-2.9719075470e-32
C133	$x^2 y^{13}$	-2.0814565975e-31	-2.5399961434e-36	-3.3053502504e-31
C135	y^{15}	1.1783879640e-31	8.4075953276e-34	-3.7373611679e-31
C136	x^{16}	-7.8215999665e-40	3.0619623218e-38	-6.6897308349e-34
C138	$x^{14} y^2$	-1.3489787144e-38	-1.3173933056e-36	4.6895739290e-33
C140	$x^{12} y^4$	-1.1060598784e-38	1.1389664289e-36	1.1898857666e-32
C142	$x^{10} y^6$	6.1126918746e-36	3.5830121770e-35	2.2562474011e-33
C144	$x^8 y^8$	-9.9472983247e-36	8.8708082757e-35	-4.7162166661e-33
C146	$x^6 y^{10}$	-1.9722176560e-34	1.0203286756e-34	-3.1596641693e-33
C148	$x^4 y^{12}$	1.9971726633e-34	7.8750419222e-35	-3.0863983815e-35
C150	$x^2 y^{14}$	1.4671080791e-33	2.2576160319e-35	-1.6654622971e-33
C152	y^{16}	1.3446089490e-33	1.2262038947e-36	-8.5600002567e-33
C154	$x^{16} y$	-7.7868904508e-43	-1.2435017428e-39	-3.5824572255e-35
C156	$x^{14} y^3$	1.3684701008e-40	-2.0040187099e-38	-1.1220164391e-34
C158	$x^{12} y^5$	1.0582375883e-38	-6.6701058772e-38	-1.0546819543e-34
C160	$x^{10} y^7$	-3.2312418322e-38	-1.6125855254e-37	-7.3766087623e-35
C162	$x^8 y^9$	-6.1553564841e-37	-2.4670225590e-37	-2.7819778494e-35
C164	$x^6 y^{11}$	9.8651072991e-38	-8.8195737950e-38	-5.6863814041e-36
C166	$x^4 y^{13}$	6.4510592866e-37	6.4803417200e-38	1.5820424567e-36
C168	$x^2 y^{15}$	2.4833942142e-35	5.9661013401e-39	3.8155787145e-35
C170	y^{17}	-5.9480019738e-36	-2.9001250967e-38	6.1896806728e-35
C171	x^{18}	4.9739730359e-45	-8.5611692145e-43	1.4782087574e-38
C173	$x^{16} y^2$	9.5905315102e-44	9.3461834401e-42	-3.9712549092e-37
C175	$x^{14} y^4$	2.9586878537e-42	-5.5978801474e-41	-1.1902486685e-36
C177	$x^{12} y^6$	-1.2329368692e-41	-7.6546844603e-40	-6.4720328444e-37
C179	$x^{10} y^8$	-5.6718288083e-40	-2.4891072483e-39	-1.0234509613e-37
C181	$x^8 y^{10}$	1.4647035933e-39	-3.6256551426e-39	1.3910832686e-37
C183	$x^6 y^{12}$	-1.2077186832e-38	-3.3874384820e-39	5.6031783554e-38
C185	$x^4 y^{14}$	2.0523944311e-38	-2.3070171968e-39	-1.0908467981e-38
C187	$x^2 y^{16}$	-1.9015363173e-38	-4.9549531406e-40	1.5464975975e-38
C189	y^{18}	2.1908630235e-37	6.9249215953e-42	2.9173777467e-37
C191	$x^{18} y$	1.7727633538e-47	1.5651442754e-44	7.7597489991e-40
C193	$x^{16} y^3$	8.9915008087e-46	2.7267428528e-43	1.6465278741e-39

C195	$x^{14}y^5$	-5.9597835170e-44	8.8910907171e-43	-8.3777551079e-40
C197	$x^{12}y^7$	-3.1648393929e-43	1.9674453312e-42	-2.3976535076e-43
C199	$x^{10}y^9$	5.0144012117e-42	4.3037657792e-42	-1.3726449580e-43
C201	x^8y^{11}	-2.0537860165e-41	4.4303832692e-42	-6.7580154863e-44
C203	x^6y^{13}	4.9281119187e-41	3.6766291837e-43	2.2538999678e-40
C205	x^4y^{15}	-3.8162288999e-40	-1.4025976322e-42	-1.9374308562e-40
C207	x^2y^{17}	1.3515085877e-40	-2.7338594450e-43	-2.0312038333e-39
C209	y^{19}	1.8651521233e-39	5.6124223098e-43	-4.0283378828e-39
C210	x^{20}	-1.4357270329e-50	8.5128605245e-48	-1.4666394325e-44
C212	$x^{18}y^2$	1.1889448948e-49	9.6496226122e-47	8.2317220740e-42
C214	$x^{16}y^4$	-6.0878348102e-48	1.3697170242e-45	2.0430686433e-41
C216	$x^{14}y^6$	-4.7355500404e-46	7.4115926977e-45	3.7700456362e-45
C218	$x^{12}y^8$	4.4693207296e-45	2.7492033686e-44	1.9013823361e-45
C220	$x^{10}y^{10}$	-1.4260151041e-44	4.9046050640e-44	1.0576715943e-45
C222	x^8y^{12}	5.4241276175e-44	5.3510591196e-44	4.4536665212e-46
C224	x^6y^{14}	-1.8962541934e-43	4.7275574418e-44	2.9715636422e-46
C226	x^4y^{16}	-6.4614525109e-43	2.9803371275e-44	1.3312751769e-42
C228	x^2y^{18}	5.7709366205e-43	5.4507385495e-45	7.2014314065e-42
C230	y^{20}	4.6374977599e-42	-1.3595188151e-45	1.0683412204e-41

用於圖3的表3c

係數	公式	M10	M11
C7	x^2y	-1.1663231269e-06	1.1921829273e-08
C9	y^3	2.2591574472e-06	-2.7002975297e-08
C10	x^4	6.6694067565e-10	-3.1865749113e-11
C12	x^2y^2	-7.0538146018e-10	-5.8763805693e-11
C14	y^4	1.3791783233e-09	2.7618522197e-13
C16	x^4y	1.5680835348e-13	3.1783330086e-15
C18	x^2y^3	-5.0982360864e-12	-1.0530824115e-14
C20	y^5	1.5153413537e-11	-4.7274565120e-14
C21	x^6	6.3513253971e-16	-3.1838489578e-17
C23	x^4y^2	1.2012523622e-14	-1.5794540943e-16
C25	x^2y^4	-6.4957845138e-15	-1.1537775260e-16
C27	y^6	1.3762303636e-14	5.9712433522e-18
C29	x^6y	-5.7897715260e-18	3.2000844761e-20
C31	x^4y^3	-6.6235683896e-18	8.7835024977e-21
C33	x^2y^5	2.3551679890e-16	-8.1378635008e-20
C35	y^7	-1.9371589833e-16	-7.8870432865e-20
C36	x^8	1.1217215851e-21	-7.1595083501e-23
C38	x^6y^2	5.5732551565e-20	-2.3196095471e-22
C40	x^4y^4	-6.2255177021e-19	-3.8707285634e-22
C42	x^2y^6	1.6145485935e-18	-1.6597527116e-22

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C44	y^8	1.1215078565e-18	1.1716622724e-23
C46	$x^8 y$	-6.1663790632e-23	-2.4058234690e-26
C48	$x^6 y^3$	6.2561777699e-22	4.4714573426e-26
C50	$x^4 y^5$	-4.5947599398e-21	-1.4719522624e-25
C52	$x^2 y^7$	-9.1165727777e-21	-2.2373818860e-25
C54	y^9	2.1177170012e-20	-1.0676714355e-25
C55	x^{10}	4.7410465567e-27	-4.2820557522e-29
C57	$x^8 y^2$	-1.4132621088e-24	-6.6137258083e-28
C59	$x^6 y^4$	3.6613789941e-24	-1.2685026942e-27
C61	$x^4 y^6$	2.6901308095e-23	-1.1420065923e-27
C63	$x^2 y^8$	-1.2262504418e-22	-3.6938615811e-28
C65	y^{10}	1.2895775113e-22	-3.9711786056e-29
C67	$x^{10} y$	1.0842810117e-27	8.5817995970e-32
C69	$x^8 y^3$	1.5649106665e-27	1.9476168011e-31
C71	$x^6 y^5$	-1.2400458862e-26	7.2361614225e-31
C73	$x^4 y^7$	4.6145315023e-25	1.4720144234e-31
C75	$x^2 y^9$	-4.0728948833e-25	-4.1772146062e-31
C77	y^{11}	9.7988616609e-25	-2.4705555621e-31
C78	x^{12}	3.9956872907e-31	-9.0354940605e-35
C80	$x^{10} y^2$	2.8501344472e-29	1.4148833708e-33
C82	$x^8 y^4$	1.5947979385e-28	3.9541954363e-33
C84	$x^6 y^6$	-6.2995605300e-28	4.8334118773e-33
C86	$x^4 y^8$	8.9050063121e-28	2.0959532721e-33
C88	$x^2 y^{10}$	-1.9194252591e-27	1.8421945106e-34
C90	y^{12}	7.9443383790e-27	1.2258733275e-34
C92	$x^{12} y$	-2.1453912253e-32	2.8877305214e-37
C94	$x^{10} y^3$	-3.0397888617e-31	8.7182316660e-38
C96	$x^8 y^5$	1.5979096613e-31	-6.2716138081e-36
C98	$x^6 y^7$	-4.8562548732e-30	-9.2865904233e-36
C100	$x^4 y^9$	-7.5175563802e-30	-6.4348190009e-36
C102	$x^2 y^{11}$	-1.9127771530e-29	-2.0889634312e-36
C104	y^{13}	3.1707472515e-29	6.3387734034e-38
C105	x^{14}	-6.6332018770e-36	1.9003748133e-40
C107	$x^{12} y^2$	-3.0902875055e-34	-1.2707556076e-38
C109	$x^{10} y^4$	-3.7955115541e-33	-5.4258348717e-38
C111	$x^8 y^6$	-9.9204822424e-34	-1.0106706383e-37
C113	$x^6 y^8$	1.6261522682e-32	-8.7178347835e-38
C115	$x^4 y^{10}$	1.3767243112e-32	-3.4926503706e-38
C117	$x^2 y^{12}$	-3.4331941911e-32	-4.3676972121e-39
C119	y^{14}	-6.1806466418e-32	-1.2324933298e-40
C121	$x^{14} y$	2.5975197067e-37	-1.3374737213e-42
C123	$x^{12} y^3$	6.4239662272e-36	2.6176103826e-43
C125	$x^{10} y^5$	1.5189330414e-35	2.9252071252e-41

C127	$x^8 y^7$	2.6584445085e-35	5.8013627472e-41
C129	$x^6 y^9$	2.5879034229e-34	6.0489428779e-41
C131	$x^4 y^{11}$	2.1189015515e-34	3.5421971957e-41
C133	$x^2 y^{13}$	6.7439880341e-34	9.8262553521e-42
C135	y^{15}	-1.3394227878e-33	-6.6744421186e-43
C136	x^{16}	5.2956977734e-41	-1.0872758046e-45
C138	$x^{14} y^2$	1.4771291367e-39	4.3905617493e-44
C140	$x^{12} y^4$	3.2848392693e-38	2.5961327928e-43
C142	$x^{10} y^6$	1.2899085039e-37	6.3726919944e-43
C144	$x^8 y^8$	-2.4484702649e-37	7.7901881038e-43
C146	$x^6 y^{10}$	7.1545737685e-38	5.0220710138e-43
C148	$x^4 y^{12}$	-2.3771571764e-36	1.4957115226e-43
C150	$x^2 y^{14}$	6.1049624783e-36	6.8304580815e-45
C152	y^{16}	-6.4492410484e-36	-2.6029279451e-45
C154	$x^{16} y$	-1.9899513319e-42	2.7986611355e-48
C156	$x^{14} y^3$	-6.7496233922e-41	-2.3407634690e-48
C158	$x^{12} y^5$	-3.6187976705e-40	-7.0182355832e-47
C160	$x^{10} y^7$	-3.0916476965e-40	-1.8366866274e-46
C162	$x^8 y^9$	-2.9750227750e-39	-3.2427055169e-46
C164	$x^6 y^{11}$	-3.5158521190e-39	-3.3343027873e-46
C166	$x^4 y^{13}$	-2.1916609772e-38	-2.0953331736e-46
C168	$x^2 y^{15}$	3.1747352996e-38	-6.7004380456e-47
C170	y^{17}	-1.2617547429e-38	-4.1819131946e-48
C171	x^{18}	-1.8824375264e-46	5.3263529060e-52
C173	$x^{16} y^2$	4.2534759115e-45	-1.1910139311e-49
C175	$x^{14} y^4$	-2.4257550168e-44	-8.3840536070e-49
C177	$x^{12} y^6$	-1.0671256186e-42	-2.5099823971e-48
C179	$x^{10} y^8$	7.0463360147e-43	-4.0224192498e-48
C181	$x^8 y^{10}$	5.2540112624e-43	-3.7849313463e-48
C183	$x^6 y^{12}$	1.3022858376e-41	-2.0055519510e-48
C185	$x^4 y^{14}$	-4.8406462056e-41	-5.0146704589e-49
C187	$x^2 y^{16}$	1.2130228813e-40	-1.4171294592e-50
C189	y^{18}	4.8106706773e-42	1.0476452918e-50
C191	$x^{18} y$	8.3958709460e-48	-1.9221682176e-54
C193	$x^{16} y^3$	3.5759206934e-46	1.3322328979e-53
C195	$x^{14} y^5$	3.0879150812e-45	8.4420576065e-53
C197	$x^{12} y^7$	5.5511480653e-45	2.4350151108e-52
C199	$x^{10} y^9$	1.3657087584e-44	6.7816148627e-52
C201	$x^8 y^{11}$	4.9398105960e-44	1.0948751508e-51
C203	$x^6 y^{13}$	1.2188999472e-43	1.0112519427e-51
C205	$x^4 y^{15}$	2.7083111619e-44	5.8621756652e-52
C207	$x^2 y^{17}$	2.8651654762e-43	1.7463285688e-52
C209	y^{19}	6.0937890687e-44	1.4331723735e-53

C210	x^{20}	1.4716572709e-52	1.8370771475e-57
C212	$x^{18}y^2$	-7.1338342986e-50	1.8492230703e-55
C214	$x^{16}y^4$	-1.1891390671e-48	1.4406362749e-54
C216	$x^{14}y^6$	-8.8693738447e-49	5.0053812022e-54
C218	$x^{12}y^8$	1.9669384553e-48	9.8670699398e-54
C220	$x^{10}y^{10}$	-3.3307534362e-47	1.2170423043e-53
C222	x^8y^{12}	4.7017462222e-47	9.3961901328e-54
C224	x^6y^{14}	1.5928343340e-46	4.2009174474e-54
C226	x^4y^{16}	1.6372391506e-46	8.9550533027e-55
C228	x^2y^{18}	2.7290698890e-46	1.5253757310e-56
C230	y^{20}	7.1653806087e-47	-1.8045578293e-56
C232	$x^{20}y$	-1.5557530817e-53	7.0627997627e-61
C234	$x^{18}y^3$	-7.6874309783e-52	-8.0490128342e-60
C236	$x^{16}y^5$	-9.2309209046e-51	-6.2054518548e-60
C238	$x^{14}y^7$	-3.0920858541e-50	-2.9024085791e-59
C240	$x^{12}y^9$	-2.4123131834e-50	-4.6996108463e-58
C242	$x^{10}y^{11}$	-2.1230649056e-49	-1.3519096896e-57
C244	x^8y^{13}	-1.5841186759e-49	-1.9064594700e-57
C246	x^6y^{15}	-1.1385423316e-49	-1.5837079270e-57
C248	x^4y^{17}	8.2942189255e-50	-8.3527425239e-58
C250	x^2y^{19}	-1.2399625495e-49	-2.3562483130e-58
C252	y^{21}	-5.4953242371e-51	-2.3769805373e-59
C253	x^{22}	6.5863530501e-58	-3.6342029038e-63
C255	$x^{20}y^2$	2.0963181489e-55	-1.4433750110e-61
C257	$x^{18}y^4$	4.9123313973e-54	-1.1596127038e-60
C259	$x^{16}y^6$	2.5005196495e-53	-4.5049908232e-60
C261	$x^{14}y^8$	2.9688471958e-53	-1.0488501650e-59
C263	$x^{12}y^{10}$	1.1384998829e-52	-1.6065880741e-59
C265	$x^{10}y^{12}$	-4.5646089365e-53	-1.6457817075e-59
C267	x^8y^{14}	4.2159820767e-53	-1.1031569638e-59
C269	x^6y^{16}	7.9379889950e-53	-4.4788812744e-60
C271	x^4y^{18}	1.3569022090e-52	-9.6477177678e-61
C273	x^2y^{20}	-2.2227634963e-52	-6.3911045981e-62
C275	y^{22}	-4.4173883147e-54	7.7024114313e-63

用於圖3的表3d

【0088】該光闌邊緣之座標

x_i [mm]	y_i [mm]	$x_{i+N/2}$ [mm]	$y_{i+N/2}$ [mm]
-371.701055	57.193754	374.436149	46.430308
-370.018750	62.373100	375.482415	40.845743
-368.131269	67.417997	376.310521	35.125798
-366.042303	72.328927	376.917804	29.270475
-363.755654	77.106483	377.301881	23.279877

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-361.275215	81.751374	377.460659	17.154214
-358.604931	86.264434	377.392348	10.893823
-355.748778	90.646625	377.095454	4.499176
-352.710738	94.899037	376.568779	-2.029091
-349.494775	99.022893	375.811402	-8.690161
-346.104819	103.019544	374.822664	-15.483004
-342.544746	106.890467	373.602137	-22.406354
-338.818365	110.637256	372.149599	-29.458676
-334.929409	114.261620	370.464992	-36.638132
-330.881523	117.765369	368.548392	-43.942552
-326.678258	121.150409	366.399966	-51.369395
-322.323071	124.418732	364.019930	-58.915712
-317.819322	127.572405	361.408515	-66.578115
-313.170273	130.613562	358.565929	-74.352732
-308.379098	133.544391	355.492320	-82.235172
-303.448885	136.367133	352.187751	-90.220492
-298.382646	139.084062	348.652172	-98.303152
-293.183323	141.697487	344.885407	-106.476988
-287.853803	144.209740	340.887138	-114.735178
-282.396921	146.623164	336.656904	-123.070210
-276.815472	148.940116	332.194105	-131.473861
-271.112223	151.162950	327.498012	-139.937173
-265.289914	153.294014	322.567786	-148.450441
-259.351268	155.335648	317.402502	-157.003201
-253.298994	157.290169	312.001185	-165.584231
-247.135790	159.159874	306.362839	-174.181554
-240.864349	160.947028	300.486497	-182.782450
-234.487356	162.653863	294.371263	-191.373479
-228.007493	164.282572	288.016360	-199.940504
-221.427438	165.835304	281.421184	-208.468729
-214.749869	167.314166	274.585355	-216.942737
-207.977466	168.721211	267.508773	-225.346539
-201.112913	170.058443	260.191668	-233.663622
-194.158903	171.327814	252.634655	-241.877003
-187.118144	172.531217	244.838786	-249.969290
-179.993361	173.670492	236.805600	-257.922745
-172.787309	174.747419	228.537169	-265.719339
-165.502772	175.763719	220.036143	-273.340830
-158.142579	176.721052	211.305793	-280.768822
-150.709603	177.621017	202.350049	-287.984847
-143.206775	178.465151	193.173534	-294.970434
-135.637084	179.254924	183.781593	-301.707191
-128.003592	179.991743	174.180318	-308.176890

-120.309431	180.676944	164.376572	-314.361556
-112.557814	181.311797	154.377994	-320.243559
-104.752034	181.897500	144.193018	-325.805712
-96.895472	182.435178	133.830862	-331.031368
-88.991594	182.925880	123.301529	-335.904532
-81.043954	183.370582	112.615786	-340.409958
-73.056195	183.770179	101.785144	-344.533264
-65.032041	184.125487	90.821823	-348.261034
-56.975301	184.437243	79.738715	-351.580926
-48.889860	184.706099	68.549330	-354.481770
-40.779674	184.932623	57.267741	-356.953668
-32.648763	185.117297	45.908520	-358.988079
-24.501203	185.260520	34.486664	-360.577902
-16.341114	185.362600	23.017520	-361.717536
-8.172653	185.423760	11.516701	-362.402944
0.000000	185.444131	0.000000	-362.631685
8.172653	185.423760	-11.516701	-362.402944
16.341114	185.362600	-23.017520	-361.717536
24.501203	185.260520	-34.486664	-360.577902
32.648763	185.117297	-45.908520	-358.988079
40.779674	184.932623	-57.267741	-356.953668
48.889860	184.706099	-68.549330	-354.481770
56.975301	184.437243	-79.738715	-351.580926
65.032041	184.125487	-90.821823	-348.261034
73.056195	183.770179	-101.785144	-344.533264
81.043954	183.370582	-112.615786	-340.409958
88.991594	182.925880	-123.301529	-335.904532
96.895472	182.435178	-133.830862	-331.031368
104.752034	181.897500	-144.193018	-325.805712
112.557814	181.311797	-154.377994	-320.243559
120.309431	180.676944	-164.376572	-314.361556
128.003592	179.991743	-174.180318	-308.176890
135.637084	179.254924	-183.781593	-301.707191
143.206775	178.465151	-193.173534	-294.970434
150.709603	177.621017	-202.350049	-287.984847
158.142579	176.721052	-211.305793	-280.768822
165.502772	175.763719	-220.036143	-273.340830
172.787309	174.747419	-228.537169	-265.719339
179.993361	173.670492	-236.805600	-257.922745
187.118144	172.531217	-244.838786	-249.969290
194.158903	171.327814	-252.634655	-241.877003
201.112913	170.058443	-260.191668	-233.663622
207.977466	168.721211	-267.508773	-225.346539

214.749869	167.314166	-274.585355	-216.942737
221.427438	165.835304	-281.421184	-208.468729
228.007493	164.282572	-288.016360	-199.940504
234.487356	162.653863	-294.371263	-191.373479
240.864349	160.947028	-300.486497	-182.782450
247.135790	159.159874	-306.362839	-174.181554
253.298994	157.290169	-312.001185	-165.584231
259.351268	155.335648	-317.402502	-157.003201
265.289914	153.294014	-322.567786	-148.450441
271.112223	151.162950	-327.498012	-139.937173
276.815472	148.940116	-332.194105	-131.473861
282.396921	146.623164	-336.656904	-123.070210
287.853803	144.209740	-340.887138	-114.735178
293.183323	141.697487	-344.885407	-106.476988
298.382646	139.084062	-348.652172	-98.303152
303.448885	136.367133	-352.187751	-90.220492
308.379098	133.544391	-355.492320	-82.235172
313.170273	130.613562	-358.565929	-74.352732
317.819322	127.572405	-361.408515	-66.578115
322.323071	124.418732	-364.019930	-58.915712
326.678258	121.150409	-366.399966	-51.369395
330.881523	117.765369	-368.548392	-43.942552
334.929409	114.261620	-370.464992	-36.638132
338.818365	110.637256	-372.149599	-29.458676
342.544746	106.890467	-373.602137	-22.406354
346.104819	103.019544	-374.822664	-15.483004
349.494775	99.022893	-375.811402	-8.690161
352.710738	94.899037	-376.568779	-2.029091
355.748778	90.646625	-377.095454	4.499176
358.604931	86.264434	-377.392348	10.893823
361.275215	81.751374	-377.460659	17.154214
363.755654	77.106483	-377.301881	23.279877
366.042303	72.328927	-376.917804	29.270475
368.131269	67.417997	-376.310521	35.125798
370.018750	62.373100	-375.482415	40.845743
371.701055	57.193754	-374.436149	46.430308
373.174643	51.879583	-373.174643	51.879583

用於圖3的表4

【0089】該等反射鏡M1、M4、M5、M6、M7、和M11對於該半徑具有負值，即其原則上係凹面鏡。該反射鏡M10具有正半徑值，亦即原則上係凸面鏡。

該等反射鏡M2、M3、M8、和M9具有在每種情況下皆具不同記號的 R_x 、 R_y 半徑值，即原則上係鞍形。

【0090】 投影光學單元7之更多資料出於以下的表5：

NA	數值孔徑	0.75
$ \beta_x $	該交叉掃描方向上的放大比例	4.3
$ \beta_y $	該掃描方向上的放大比例	8.0
RMS	掃描波前偏差	7.7 mλ
N	反射鏡之數量	11

用於圖3的表5

【0091】 投影光學單元31具有3468 mm之物件/影像偏移a。該作業距離b係存在於物件平面5與在投影光學單元31之該情況下與其最接近的反射鏡M5之該反射部位之間，並為277 mm。該經向橫向尺寸c係存在於分隔平面31a與在投影光學單元31之該情況下與其相距最遠的該反射鏡M11之該反射部位之間，並為4112 mm。

【0092】 該比率a/c在投影光學單元31之該情況下為0.84。該比率b/c在投影光學單元31之該情況下為0.067。

【0093】 圖4顯示可在投影曝光設備1（而非投影光學單元7）中使用的投影光學單元或成像光學單元32之又一具體實施例。對應於以上參照圖1至圖3並特別是與圖2和圖3搭配已解說者的部件和功能，係藉由相同元件符號而表示並係不再詳細討論。

【0094】 投影光學單元32具有0.75之影像側數值孔徑。

【0095】 依據圖4的投影光學單元32具有總共九個反射鏡M1至M9。該等反射鏡M1、M8、和M9係體現為用於正向入射的反射鏡（NI反射鏡）。該等反射鏡M2至M7係每個皆體現為用於掠入射的反射鏡（GI反射鏡）。因此，投影光學單元32包含三個NI反射鏡和六個GI反射鏡。

【0096】該等NI反射鏡M2至M7反射成像光3使得：該等個別光線29在該等各自反射鏡M2至M7處之該等反射角相加，即導致其該偏轉效應之放大。投影光學單元32沒有反向GI影像。

【0097】投影光學單元32在該物件側上為大致遠心。若該成像波束路徑係僅關於通過物件場4的該等個別光線列入考慮，則該入射光瞳係位於該xz平面中物件場4之下游4161.14 mm，以及該yz平面中物件場4之上游8870.82 mm。

【0098】在投影光學單元32中，光瞳平面係位於該等反射鏡M1與M2之間的該成像波束路徑中。第一中間影像平面係位於該等反射鏡M2與M3之間的該波束路徑中。又一光瞳平面係位於該等反射鏡M3與M4之間。又一中間影像平面係位於該反射鏡M5上的該反射區域中。中間影像平面之該數量不同於依據圖47的該經向平面中的中間影像之該數量，不同於與其垂直的平面中的中間影像之該數量。在相互垂直平面中具中間影像之不同數量的此類投影光學單元，原則上係從WO 2016/166080 A1和DE 10 2015 226 531 A1已知。

【0099】除了GI反射鏡之該數量並欠缺反向GI反射鏡之設置之外，投影光學單元32（在其基本結構方面）對應於投影光學單元31。

【0100】用於依據圖4的投影光學單元32的該光學設計資料從下列表1至表5顯現，這對應於與依據圖2和圖3的該具體實施例相關的表1至表5。

【0101】該等表面之半徑

	Radius_x [mm]	Power_x [1/mm]	Radius_y [mm]	Power_y [1/mm]
M01	-3931.11630815	0.00049656	-1570.16464240	0.00124320
M02	9512.50982020	-0.00002036	2049.16697170	-0.00009454
M03	-91911.65122096	0.00000493	-2602.53714561	0.00017414
M04	-8651.81713679	0.00004489	-6046.86509997	0.00006423
M05	-5333.06971216	0.00003112	39552.26448106	-0.00000420
M06	-1352.11765463	0.00062514	-77594.92535249	0.00001089
M07	-2009.01512338	0.00015842	-1052559.66276600	0.00000030
M08	3102.28733421	-0.00057798	350.18779350	-0.00512030
M09	-928.41786149	0.00213630	-837.58384060	0.00236798

用於圖4的表1

【0102】偏心（位置、角度）該等表面

D_x [mm]

D_y [mm]

D_z [mm]

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Reticle	0.000000000	0.000000000	0.000000000
M01	0.000000000	-211.605112018	2247.749211410
M02	0.000000000	-466.238794346	1256.764264416
M03	0.000000000	-830.524863567	854.643609596
M04	0.000000000	-1749.684424872	392.268623409
M05	0.000000000	-2665.245104306	276.266123045
M06	0.000000000	-3203.432432941	343.977562379
M07	0.000000000	-3527.522530730	752.909191048
M08	0.000000000	-3873.868039472	2404.329641621
Stop	0.000000000	-3850.746553899	2294.083389947
M09	0.000000000	-3731.228414250	1724.205348944
Wafer	0.000000000	-3731.228414184	2499.960932794

	$\alpha_x [^\circ]$	$\alpha_y [^\circ]$	$\alpha_z [^\circ]$
Reticle	0.000000000	0.000000000	0.000000000
M01	-4.516194018	0.000000000	0.000000000
M02	241.707883459	0.000000000	-0.000000000
M03	217.265226606	-0.000000000	-0.000000000
M04	196.962616285	-0.000000000	-0.000000000
M05	180.025016609	-0.000000000	-0.000000000
M06	150.613455982	-0.000000000	-0.000000000
M07	115.121285503	-0.000000000	-0.000000000
M08	11.844732475	0.000000000	-0.000000000
Stop	178.951384148	-0.000000000	-0.000000000
M09	185.922366235	-0.000000000	-0.000000000
Wafer	-0.000000005	0.000000000	180.000000000

用於圖4的表2

【0103】該等表面之自由形式係數

係數	公式	M01	M02	M03
C2	y	-2.8035400493e-04	-1.6448533553e-03	-8.1992834859e-04
C7	$x^2 y$	-4.0339570673e-09	-1.4265193251e-07	-1.5045516468e-07
C9	y^3	-1.4380695310e-08	6.9599256764e-07	7.1973243071e-08
C10	x^4	2.1535869995e-11	3.9718754449e-11	3.4225516079e-11
C12	$x^2 y^2$	1.0121822719e-11	-7.8806415289e-10	9.4867156461e-11
C14	y^4	-2.3214890328e-11	7.1914918084e-10	-4.0271812483e-11
C16	$x^4 y$	2.7852549771e-14	2.2186203226e-13	1.3159111447e-13
C18	$x^2 y^3$	-2.0859708359e-14	-1.5392968391e-12	-7.5759629529e-14
C20	y^5	-5.6995662783e-14	-5.0666504433e-12	8.8973157640e-14
C21	x^6	2.5786707517e-17	-1.2548649733e-16	-2.9457886234e-16
C23	$x^4 y^2$	3.4859066581e-17	4.1217458586e-16	-4.6755938349e-17
C25	$x^2 y^4$	-1.8344996941e-17	-2.8240228462e-15	1.3367514212e-16

C27	y^6	-1.0648759341e-16	-5.2123844722e-14	9.3023660680e-16
C29	$x^6 y$	8.1376082326e-21	1.1699024297e-19	4.8075419760e-21
C31	$x^4 y^3$	1.0782185972e-19	-3.2979326062e-18	-4.6608002541e-20
C33	$x^2 y^5$	-3.5912132978e-21	1.9831366355e-17	-3.4583978760e-19
C35	y^7	-3.0906795136e-19	-3.5591471028e-16	-4.9693813006e-18
C36	x^8	1.5671007700e-23	-7.2916040661e-22	-1.6146300607e-21
C38	$x^6 y^2$	5.0195942922e-23	5.2196521238e-21	3.4914926160e-22
C40	$x^4 y^4$	8.7802022030e-23	-3.1881628357e-20	1.2757168190e-22
C42	$x^2 y^6$	-1.9144971898e-22	3.0429844582e-19	-1.7640353737e-20
C44	y^8	-1.8896345075e-21	-1.5021253713e-18	-4.7852043740e-20
C46	$x^8 y$	-3.6709847965e-25	2.1295523826e-24	1.9100631517e-24
C48	$x^6 y^3$	-2.7400276816e-24	4.2544477421e-23	-1.1512547475e-25
C50	$x^4 y^5$	-6.8334963849e-24	-1.3823316678e-22	8.1487362262e-24
C52	$x^2 y^7$	-4.1563573338e-24	2.6352073752e-21	-2.3650220370e-23
C54	y^9	6.8758832365e-24	1.0614487970e-21	3.9226883475e-22
C55	x^{10}	-1.9962184434e-28	2.4618729684e-27	8.0329108849e-27
C57	$x^8 y^2$	-1.0543328283e-27	-5.1058266225e-27	-1.7482282318e-27
C59	$x^6 y^4$	1.3228047093e-27	3.1972290836e-25	-1.0120190869e-26
C61	$x^4 y^6$	1.0846113186e-26	-1.1863805003e-24	2.0634081662e-25
C63	$x^2 y^8$	1.9251684835e-26	9.4882245555e-24	8.7053203606e-25
C65	y^{10}	2.2022467633e-25	3.0536533866e-23	1.8341252643e-24
C67	$x^{10} y$	7.6323638913e-30	-1.8583365267e-29	-8.9313041345e-30
C69	$x^8 y^3$	8.4202030441e-29	-3.5189138561e-28	-9.3489338712e-32
C71	$x^6 y^5$	3.5859900550e-28	-6.8011041903e-28	-1.9146783857e-28
C73	$x^4 y^7$	7.4168868476e-28	-1.8328795163e-26	3.2563675364e-28
C75	$x^2 y^9$	-9.4459308196e-29	-3.1706314139e-26	1.3044082536e-27
C77	y^{11}	-6.0054042995e-28	1.2334232039e-26	-2.5726922000e-26
C78	x^{12}	1.8541449239e-33	-5.2391990154e-33	-4.0114952403e-32
C80	$x^{10} y^2$	1.4680539713e-32	9.8314735561e-33	-2.7917715845e-34
C82	$x^8 y^4$	-7.8676740834e-32	-1.9232206365e-30	1.3626045847e-31
C84	$x^6 y^6$	-1.0788249758e-30	-5.5461660647e-31	-1.2079816853e-30
C86	$x^4 y^8$	-1.7712475904e-30	-2.1856773191e-29	-1.0130696138e-29
C88	$x^2 y^{10}$	-1.3471823074e-30	-3.4613462211e-28	-2.5305198323e-29
C90	y^{12}	-1.4429973874e-29	6.0289181525e-28	-5.2612034015e-29
C92	$x^{12} y$	-1.3285941055e-34	1.0986998869e-34	4.9312519077e-35
C94	$x^{10} y^3$	-1.8728839241e-33	1.5183939089e-33	-9.6120635102e-36
C96	$x^8 y^5$	-1.0711375454e-32	1.3164715014e-32	1.4723135607e-33
C98	$x^6 y^7$	-3.5056894197e-32	1.4583876130e-31	5.0346596370e-33
C100	$x^4 y^9$	-5.5558550295e-32	1.0095938158e-30	-4.3197623857e-32
C102	$x^2 y^{11}$	2.8003327721e-32	-9.0535377855e-31	4.8295403248e-32
C104	y^{13}	3.9728487120e-32	1.0911580202e-29	1.0008404959e-30
C105	x^{14}	-1.6829759824e-38	-8.0840904297e-39	1.2801127188e-37
C107	$x^{12} y^2$	-1.0467858664e-37	-3.0727509908e-37	-1.0787284463e-38

C109	$x^{10}y^4$	2.2932241841e-36	5.1953742882e-36	-7.5380122253e-37
C111	x^8y^6	3.4019952946e-35	2.7622159003e-35	2.8736627198e-36
C113	x^6y^8	1.2870985168e-34	-1.9581153375e-34	6.0740560662e-35
C115	x^4y^{10}	7.1434992901e-35	4.4436347487e-33	1.6795913244e-34
C117	x^2y^{12}	1.3752280668e-35	-4.1116650942e-33	6.4081860049e-34
C119	y^{14}	5.8282157419e-34	-6.9254175620e-34	7.4755488932e-34
C121	$x^{14}y$	1.6006404041e-39	-4.5994587629e-40	-1.9108797125e-40
C123	$x^{12}y^3$	2.7806963650e-38	-4.9175955768e-39	1.8155394553e-40
C125	$x^{10}y^5$	2.0415479612e-37	-8.3058357142e-38	-4.5884494595e-39
C127	x^8y^7	8.7837766468e-37	-9.0957343223e-37	-5.0941053283e-38
C129	x^6y^9	2.3228792342e-36	-8.7364551678e-36	7.0388472944e-38
C131	x^4y^{11}	2.5480650127e-36	-7.6182058023e-36	9.0337718156e-37
C133	x^2y^{13}	-2.5330279174e-36	-3.2455989608e-35	-2.4962950651e-36
C135	y^{15}	-2.2061284181e-36	-5.2546457066e-34	-2.1537930115e-35
C136	x^{16}	1.1383116153e-43	4.6134601534e-44	-1.6732317081e-43
C138	$x^{14}y^2$	6.6583041568e-44	7.4028014380e-43	5.1516847865e-44
C140	$x^{12}y^4$	-3.5532663366e-41	-3.2291663065e-42	1.4283597547e-42
C142	$x^{10}y^6$	-5.5386341132e-40	-6.1624931086e-41	-7.0855340081e-43
C144	x^8y^8	-3.1233928680e-39	1.0206311584e-39	-1.2377309847e-40
C146	x^6y^{10}	-6.3759298763e-39	-1.0993194156e-38	-6.7456031568e-40
C148	x^4y^{12}	1.6422430558e-39	-6.0007280149e-38	-9.3697874041e-40
C150	x^2y^{14}	2.5031551277e-39	-9.8784556327e-38	-9.3457850511e-39
C152	y^{16}	-1.5889338968e-38	-2.5334051941e-36	2.5198928582e-40
C154	$x^{16}y$	-1.2901300057e-44	7.8364334518e-46	3.0383372734e-46
C156	$x^{14}y^3$	-2.7001791597e-43	6.1181768185e-45	-4.6804178507e-46
C158	$x^{12}y^5$	-2.4669412150e-42	1.7061739955e-43	4.7561262422e-45
C160	$x^{10}y^7$	-1.3408169830e-41	2.3779830514e-42	1.0910367772e-43
C162	x^8y^9	-4.6537303136e-41	2.5810336301e-41	4.1542091892e-43
C164	x^6y^{11}	-9.7599138870e-41	7.3112347639e-41	-1.9958832693e-42
C166	x^4y^{13}	-5.9459311599e-41	-4.8220899053e-41	-4.7351257764e-42
C168	x^2y^{15}	1.2720447494e-40	-8.4809471974e-41	2.4401389987e-41
C170	y^{17}	8.2411634751e-41	-3.7518921770e-39	2.1345403254e-40
C171	x^{18}	-5.2010804722e-49	0.0000000000e+00	0.0000000000e+00
C173	$x^{16}y^2$	4.6552952197e-48	0.0000000000e+00	0.0000000000e+00
C175	$x^{14}y^4$	3.1771147417e-46	0.0000000000e+00	0.0000000000e+00
C177	$x^{12}y^6$	5.2114551883e-45	0.0000000000e+00	0.0000000000e+00
C179	$x^{10}y^8$	3.7966577141e-44	0.0000000000e+00	0.0000000000e+00
C181	x^8y^{10}	1.2968787476e-43	0.0000000000e+00	0.0000000000e+00
C183	x^6y^{12}	1.4542909181e-43	0.0000000000e+00	0.0000000000e+00
C185	x^4y^{14}	-2.1274209641e-43	0.0000000000e+00	0.0000000000e+00
C187	x^2y^{16}	-1.3772108729e-43	0.0000000000e+00	0.0000000000e+00
C189	y^{18}	2.8828999315e-43	0.0000000000e+00	0.0000000000e+00
C191	$x^{18}y$	6.8747666500e-50	0.0000000000e+00	0.0000000000e+00

C193	$x^{16}y^3$	1.6916457672e-48	0.0000000000e+00	0.0000000000e+00
C195	$x^{14}y^5$	1.8657042468e-47	0.0000000000e+00	0.0000000000e+00
C197	$x^{12}y^7$	1.2497955372e-46	0.0000000000e+00	0.0000000000e+00
C199	$x^{10}y^9$	5.4091025908e-46	0.0000000000e+00	0.0000000000e+00
C201	x^8y^{11}	1.5332821025e-45	0.0000000000e+00	0.0000000000e+00
C203	x^6y^{13}	2.4431547493e-45	0.0000000000e+00	0.0000000000e+00
C205	x^4y^{15}	2.2357622797e-46	0.0000000000e+00	0.0000000000e+00
C207	x^2y^{17}	-3.8156071226e-45	0.0000000000e+00	0.0000000000e+00
C209	y^{19}	-1.9780451731e-45	0.0000000000e+00	0.0000000000e+00
C210	x^{20}	1.5074597316e-54	0.0000000000e+00	0.0000000000e+00
C212	$x^{18}y^2$	-3.5024384387e-53	0.0000000000e+00	0.0000000000e+00
C214	$x^{16}y^4$	-1.6498258573e-51	0.0000000000e+00	0.0000000000e+00
C216	$x^{14}y^6$	-2.8501261062e-50	0.0000000000e+00	0.0000000000e+00
C218	$x^{12}y^8$	-2.5116502593e-49	0.0000000000e+00	0.0000000000e+00
C220	$x^{10}y^{10}$	-1.1751075664e-48	0.0000000000e+00	0.0000000000e+00
C222	x^8y^{12}	-2.7048362223e-48	0.0000000000e+00	0.0000000000e+00
C224	x^6y^{14}	-1.0365538736e-48	0.0000000000e+00	0.0000000000e+00
C226	x^4y^{16}	6.7278997311e-48	0.0000000000e+00	0.0000000000e+00
C228	x^2y^{18}	3.1593457232e-48	0.0000000000e+00	0.0000000000e+00
C230	y^{20}	-3.3426013289e-48	0.0000000000e+00	0.0000000000e+00
C232	$x^{20}y$	-2.3275454579e-55	0.0000000000e+00	0.0000000000e+00
C234	$x^{18}y^3$	-6.5838004778e-54	0.0000000000e+00	0.0000000000e+00
C236	$x^{16}y^5$	-8.5358922407e-53	0.0000000000e+00	0.0000000000e+00
C238	$x^{14}y^7$	-6.8601309056e-52	0.0000000000e+00	0.0000000000e+00
C240	$x^{12}y^9$	-3.6346432388e-51	0.0000000000e+00	0.0000000000e+00
C242	$x^{10}y^{11}$	-1.2811570294e-50	0.0000000000e+00	0.0000000000e+00
C244	x^8y^{13}	-2.9597819821e-50	0.0000000000e+00	0.0000000000e+00
C246	x^6y^{15}	-3.3113941481e-50	0.0000000000e+00	0.0000000000e+00
C248	x^4y^{17}	2.0137888698e-50	0.0000000000e+00	0.0000000000e+00
C250	x^2y^{19}	6.7673907223e-50	0.0000000000e+00	0.0000000000e+00
C252	y^{21}	2.9295025055e-50	0.0000000000e+00	0.0000000000e+00
C253	x^{22}	-2.4603692380e-60	0.0000000000e+00	0.0000000000e+00
C255	$x^{20}y^2$	1.0973062012e-58	0.0000000000e+00	0.0000000000e+00
C257	$x^{18}y^4$	4.6269535664e-57	0.0000000000e+00	0.0000000000e+00
C259	$x^{16}y^6$	8.4202946903e-56	0.0000000000e+00	0.0000000000e+00
C261	$x^{14}y^8$	8.6149657028e-55	0.0000000000e+00	0.0000000000e+00
C263	$x^{12}y^{10}$	5.0760581892e-54	0.0000000000e+00	0.0000000000e+00
C265	$x^{10}y^{12}$	1.7018652219e-53	0.0000000000e+00	0.0000000000e+00
C267	x^8y^{14}	2.6418541764e-53	0.0000000000e+00	0.0000000000e+00
C269	x^6y^{16}	-1.2369940506e-53	0.0000000000e+00	0.0000000000e+00
C271	x^4y^{18}	-9.4447695548e-53	0.0000000000e+00	0.0000000000e+00
C273	x^2y^{20}	-3.4638064037e-53	0.0000000000e+00	0.0000000000e+00
C275	y^{22}	2.2803655011e-53	0.0000000000e+00	0.0000000000e+00

C277	$x^{22}y$	4.5360799915e-61	0.0000000000e+00	0.0000000000e+00
C279	$x^{20}y^3$	1.4474213680e-59	0.0000000000e+00	0.0000000000e+00
C281	$x^{18}y^5$	2.1591104991e-58	0.0000000000e+00	0.0000000000e+00
C283	$x^{16}y^7$	2.0291925467e-57	0.0000000000e+00	0.0000000000e+00
C285	$x^{14}y^9$	1.2891319706e-56	0.0000000000e+00	0.0000000000e+00
C287	$x^{12}y^{11}$	5.5300139583e-56	0.0000000000e+00	0.0000000000e+00
C289	$x^{10}y^{13}$	1.6132195435e-55	0.0000000000e+00	0.0000000000e+00
C291	x^8y^{15}	2.9862645686e-55	0.0000000000e+00	0.0000000000e+00
C293	x^6y^{17}	1.9042632836e-55	0.0000000000e+00	0.0000000000e+00
C295	x^4y^{19}	-4.1396281321e-55	0.0000000000e+00	0.0000000000e+00
C297	x^2y^{21}	-6.5369599736e-55	0.0000000000e+00	0.0000000000e+00
C299	y^{23}	-2.4271746030e-55	0.0000000000e+00	0.0000000000e+00
C300	x^{24}	1.6865566354e-66	0.0000000000e+00	0.0000000000e+00
C302	$x^{22}y^2$	-1.3218969952e-64	0.0000000000e+00	0.0000000000e+00
C304	$x^{20}y^4$	-5.4230015849e-63	0.0000000000e+00	0.0000000000e+00
C306	$x^{18}y^6$	-1.0401476060e-61	0.0000000000e+00	0.0000000000e+00
C308	$x^{16}y^8$	-1.2001601142e-60	0.0000000000e+00	0.0000000000e+00
C310	$x^{14}y^{10}$	-8.4941982153e-60	0.0000000000e+00	0.0000000000e+00
C312	$x^{12}y^{12}$	-3.6856639792e-59	0.0000000000e+00	0.0000000000e+00
C314	$x^{10}y^{14}$	-9.2680758504e-59	0.0000000000e+00	0.0000000000e+00
C316	x^8y^{16}	-8.5859029721e-59	0.0000000000e+00	0.0000000000e+00
C318	x^6y^{18}	1.7584577359e-58	0.0000000000e+00	0.0000000000e+00
C320	x^4y^{20}	5.0909627775e-58	0.0000000000e+00	0.0000000000e+00
C322	x^2y^{22}	1.4777719596e-58	0.0000000000e+00	0.0000000000e+00
C324	y^{24}	-7.2040307491e-59	0.0000000000e+00	0.0000000000e+00
C326	$x^{24}y$	-3.8753396347e-67	0.0000000000e+00	0.0000000000e+00
C328	$x^{22}y^3$	-1.3737971995e-65	0.0000000000e+00	0.0000000000e+00
C330	$x^{20}y^5$	-2.3177535183e-64	0.0000000000e+00	0.0000000000e+00
C332	$x^{18}y^7$	-2.4930374948e-63	0.0000000000e+00	0.0000000000e+00
C334	$x^{16}y^9$	-1.8559546738e-62	0.0000000000e+00	0.0000000000e+00
C336	$x^{14}y^{11}$	-9.5385810418e-62	0.0000000000e+00	0.0000000000e+00
C338	$x^{12}y^{13}$	-3.3807095747e-61	0.0000000000e+00	0.0000000000e+00
C340	$x^{10}y^{15}$	-8.2292905811e-61	0.0000000000e+00	0.0000000000e+00
C342	x^8y^{17}	-1.1695390480e-60	0.0000000000e+00	0.0000000000e+00
C344	x^6y^{19}	-7.5294071607e-62	0.0000000000e+00	0.0000000000e+00
C346	x^4y^{21}	2.5628883928e-60	0.0000000000e+00	0.0000000000e+00
C348	x^2y^{23}	2.6452321744e-60	0.0000000000e+00	0.0000000000e+00
C350	y^{25}	8.5436508124e-61	0.0000000000e+00	0.0000000000e+00

用於圖4的表3a

係數	公式	M04	M05	M06
C2	y	4.6035967040e-04	4.2479022324e-04	-1.4460348051e-03

C7	x^2y	-1.7643375831e-08	-1.1338573083e-08	3.1439768924e-08
C9	y^3	1.1528125385e-08	-4.1185294086e-09	-4.0468973801e-09
C10	x^4	6.5593351045e-11	-7.6643929413e-11	4.8014291149e-12
C12	x^2y^2	1.9091348846e-11	1.1364378618e-11	-3.0966577413e-11
C14	y^4	-1.2588382315e-11	1.3701842199e-11	8.6863010388e-11
C16	x^4y	-5.5910485534e-14	1.3443303219e-13	-4.1095241663e-14
C18	x^2y^3	-2.6997808773e-14	-2.7166057150e-14	7.1889204007e-15
C20	y^5	-8.7706393844e-15	-9.7703222446e-15	-1.6090687634e-13
C21	x^6	-1.2201045039e-16	1.1154016196e-16	7.1161579471e-18
C23	x^4y^2	1.2815963979e-17	-1.3515097010e-16	-8.7856899972e-17
C25	x^2y^4	-8.2873735111e-18	-3.0030214659e-17	-1.0011525737e-16
C27	y^6	-1.3764442088e-17	-8.7071098527e-17	-6.7886456239e-15
C29	x^6y	4.8957213545e-20	-2.7482753799e-19	-1.3658847912e-20
C31	x^4y^3	-2.0543759784e-21	4.8564114281e-20	4.4524082811e-19
C33	x^2y^5	-1.8327091886e-21	-4.0867022535e-19	-2.8869684177e-17
C35	y^7	-3.0043141716e-21	1.2078475874e-18	3.5367835719e-17
C36	x^8	-6.6730371273e-23	-4.9868316899e-23	5.6736118081e-23
C38	x^6y^2	-1.7128533557e-23	1.4613727334e-22	5.1615574620e-22
C40	x^4y^4	1.1435072933e-22	-9.3017126702e-22	-4.7169137737e-20
C42	x^2y^6	1.5102293558e-22	4.9695201041e-21	1.3937127057e-19
C44	y^8	8.2954505580e-23	1.6861482733e-21	6.2440903513e-20
C46	x^8y	5.3472779336e-25	5.2343796302e-25	8.9019480836e-25
C48	x^6y^3	-4.2537254329e-25	-1.1258528493e-24	-3.7134964045e-23
C50	x^4y^5	-9.7979646353e-25	9.9839670198e-24	2.8569149209e-22
C52	x^2y^7	-1.4732437699e-24	-9.6929057343e-25	2.3681014554e-22
C54	y^9	-6.6706131971e-25	-6.9161874166e-23	-1.4203837398e-21
C55	x^{10}	-3.5224466642e-29	1.9957655023e-28	1.0226231714e-28
C57	x^8y^2	-4.2748027627e-28	-1.0901321568e-27	-1.4663336937e-26
C59	x^6y^4	-9.1617082881e-28	1.3763971885e-26	3.2379325041e-25
C61	x^4y^6	-2.7610541638e-27	-6.7566362123e-27	9.5014063625e-25
C63	x^2y^8	-5.8508303957e-27	-2.7265694062e-25	-4.6034176839e-24
C65	y^{10}	-3.5213520429e-27	2.3862752675e-25	-5.7483546686e-24
C67	$x^{10}y$	-2.2494177966e-30	-2.1100651228e-30	-8.2079987250e-30
C69	x^8y^3	5.4279174255e-30	1.3494997255e-29	1.7124237614e-28
C71	x^6y^5	2.2501380493e-29	-2.2270966167e-29	9.5129914926e-28
C73	x^4y^7	3.9132948108e-29	-5.4102053544e-28	-9.0548018099e-27
C75	x^2y^9	5.2105642109e-29	1.2959435944e-27	-2.5383572792e-26
C77	y^{11}	1.1229872145e-29	8.9006221989e-28	8.9845489264e-26
C78	x^{12}	1.7375383919e-33	-1.9059488347e-33	-3.4648040526e-34
C80	$x^{10}y^2$	8.5487105053e-34	1.5621438023e-32	3.6491245469e-32
C82	x^8y^4	-8.4648600815e-33	-3.4750753279e-32	3.6280240948e-31
C84	x^6y^6	-3.0168976195e-32	-7.5134795936e-31	-1.7131610781e-29
C86	x^4y^8	5.7355199361e-32	2.9721825736e-30	-9.1882003894e-29

C88	$x^2 y^{10}$	9.2829088230e-32	2.2549223578e-30	3.3289102135e-28
C90	y^{12}	7.0583029137e-32	-7.2414460941e-30	-1.1913134267e-28
C92	$x^{12} y$	5.9350679257e-36	3.9447837666e-37	2.6470340457e-35
C94	$x^{10} y^3$	-3.3115591909e-35	-4.8830105952e-35	4.0679106787e-34
C96	$x^8 y^5$	-2.0146868466e-34	-6.2979241641e-34	-1.3083361021e-32
C98	$x^6 y^7$	-5.5189911344e-34	4.4185035602e-33	-1.3752387714e-31
C100	$x^4 y^9$	-6.9106487795e-34	2.1572513104e-33	6.0464874654e-31
C102	$x^2 y^{11}$	-1.2793425808e-33	-3.1287206959e-32	-8.6618446129e-31
C104	y^{13}	1.7006247893e-34	9.7638568791e-33	-2.0192926345e-30
C105	x^{14}	-3.9513959629e-39	6.9653649110e-39	-4.7385801045e-39
C107	$x^{12} y^2$	1.9611029970e-40	-7.9590547641e-38	2.8596552573e-37
C109	$x^{10} y^4$	1.5056245963e-37	-4.5725206337e-37	-3.2588645221e-36
C111	$x^8 y^6$	9.4242214152e-37	5.0510561424e-36	-7.5301483789e-35
C113	$x^6 y^8$	8.8447443876e-37	4.0783057960e-37	1.0745543996e-33
C115	$x^4 y^{10}$	-1.6720724017e-37	-5.9514316719e-35	-9.0969369304e-34
C117	$x^2 y^{12}$	-1.8421587738e-36	6.5477405837e-35	-5.1726522685e-33
C119	y^{14}	3.9973011677e-37	3.0986894323e-35	2.5166960919e-33
C121	$x^{14} y$	-8.5200931010e-42	3.0459290798e-41	-4.5991893622e-41
C123	$x^{12} y^3$	6.6961456462e-41	-1.7045551425e-40	-1.4764540671e-39
C125	$x^{10} y^5$	3.4955968208e-40	3.3487733370e-39	-2.8215002598e-38
C127	$x^8 y^7$	1.5540220063e-39	-2.3886100945e-39	1.1476321908e-36
C129	$x^6 y^9$	4.1694171119e-39	-6.5875604124e-38	7.7242085699e-37
C131	$x^4 y^{11}$	7.1573976929e-39	1.4504552830e-37	-7.5863733168e-37
C133	$x^2 y^{13}$	1.4074057977e-38	4.9590116924e-38	1.2005763197e-35
C135	y^{15}	-3.5972898324e-39	-8.4803955226e-38	3.2783960491e-35
C136	x^{16}	7.3843284985e-45	-8.1980105223e-45	1.9050227234e-44
C138	$x^{14} y^2$	-2.8038825947e-45	1.5992905280e-43	-1.0644871334e-42
C140	$x^{12} y^4$	-4.7903056315e-43	2.2964809680e-42	-2.4212687480e-41
C142	$x^{10} y^6$	-4.1855002977e-42	-6.1902593156e-42	5.7119964512e-40
C144	$x^8 y^8$	-1.1269169710e-41	-4.4851614288e-41	1.0081850630e-39
C146	$x^6 y^{10}$	-3.1669058190e-42	1.4952137291e-40	2.4731421183e-39
C148	$x^4 y^{12}$	-8.5742590324e-42	1.8048945410e-41	2.1885615033e-38
C150	$x^2 y^{14}$	2.8620341503e-41	-2.8146462989e-40	9.7395235871e-38
C152	y^{16}	-2.3372739555e-41	-9.3262549711e-42	-4.6124848976e-38
C154	$x^{16} y$	5.9834891399e-48	-5.9666115815e-47	1.3360193977e-46
C156	$x^{14} y^3$	1.6481466093e-47	1.1046215321e-45	-9.3569334766e-45
C158	$x^{12} y^5$	1.0787538529e-45	-7.2373341113e-46	9.8704399718e-44
C160	$x^{10} y^7$	7.1840832836e-45	-2.7485709058e-44	3.0525258910e-43
C162	$x^8 y^9$	6.7833697738e-45	9.2524406295e-44	8.7172215515e-43
C164	$x^6 y^{11}$	-4.0355561949e-46	-2.6327654695e-44	3.3100741915e-42
C166	$x^4 y^{13}$	-6.1130937123e-44	-3.0399531217e-43	8.0820796068e-41
C168	$x^2 y^{15}$	-6.3713164928e-45	1.9916980911e-43	-1.8887869848e-41
C170	y^{17}	-3.4456053003e-44	1.2588779208e-43	-6.0437373060e-41

係數	公式	M07	M08	M09
C2	y	1.7919082265e-02	2.2354011687e-01	4.6143819312e-02
C7	x ² y	-1.1672423084e-07	-6.4824823204e-07	2.2926688501e-08
C9	y ³	1.4370301300e-08	2.7774861063e-06	4.6479617874e-08
C10	x ⁴	6.9040473284e-11	4.7599489311e-10	-1.6260802968e-11
C12	x ² y ²	-9.3778973808e-11	1.8423252132e-09	-4.6268220481e-11
C14	y ⁴	-1.1154632595e-11	1.1003751016e-08	-2.0851442909e-11
C16	x ⁴ y	5.8800397669e-14	-3.0918283215e-13	2.3191302108e-14
C18	x ² y ³	6.4115588877e-15	2.9696591699e-12	6.9559678853e-14
C20	y ⁵	2.5295409085e-15	6.1614108756e-11	4.8358777380e-14
C21	x ⁶	-7.1946527648e-17	-4.4890605268e-16	-8.4280830509e-18
C23	x ⁴ y ²	-9.7527345973e-17	1.0174990249e-14	-1.0121543658e-16
C25	x ² y ⁴	7.6031583773e-17	5.1689131032e-14	-1.1003135447e-16
C27	y ⁶	6.2580985029e-17	3.5956631183e-13	-3.4607661833e-17
C29	x ⁶ y	-1.2664540925e-19	-5.6753779291e-18	9.9606407078e-21
C31	x ⁴ y ³	-6.3323286131e-19	2.7134327828e-17	1.0604665922e-19
C33	x ² y ⁵	-7.6791008974e-19	2.6708260186e-16	1.4373504781e-19
C35	y ⁷	-1.5116058751e-19	2.4037708886e-15	6.1280088804e-20
C36	x ⁸	-8.3978320004e-22	-1.2921570680e-21	8.8420264741e-24
C38	x ⁶ y ²	5.9017307028e-22	-2.9842585499e-20	-1.5544072540e-22
C40	x ⁴ y ⁴	3.2080602542e-21	4.1607078307e-19	-2.9493763825e-22
C42	x ² y ⁶	1.4977555855e-21	2.4096784455e-18	-2.1100574101e-22
C44	y ⁸	-2.2407098234e-22	1.7215701525e-17	-5.9222213359e-23
C46	x ⁸ y	-3.2135337805e-24	3.9452129829e-23	-2.0108708549e-26
C48	x ⁶ y ³	-5.9108759679e-24	-4.4802744870e-22	1.4586933764e-25
C50	x ⁴ y ⁵	-3.0903187728e-24	1.9463320101e-21	2.9946107792e-25
C52	x ² y ⁷	4.3458302622e-24	1.9206388470e-20	2.5305866324e-25
C54	y ⁹	8.8141041142e-25	1.1591853171e-19	7.6198663455e-26
C55	x ¹⁰	9.4773249908e-27	3.5741305990e-26	-4.8657072328e-29
C57	x ⁸ y ²	6.9979748186e-27	1.5632705341e-24	-1.7921075595e-28
C59	x ⁶ y ⁴	7.5959994705e-27	2.5570557553e-24	-5.1243590425e-28
C61	x ⁴ y ⁶	-4.3204448271e-26	1.6292936926e-23	-5.6991580324e-28
C63	x ² y ⁸	-1.3242121198e-26	1.5036981157e-22	-3.5016835468e-28
C65	y ¹⁰	3.4356615684e-27	5.8394442003e-22	-8.2479703316e-29
C67	x ¹⁰ y	-1.6325740473e-29	-1.1140077720e-27	7.3707775774e-32
C69	x ⁸ y ³	-1.2317472634e-28	1.2801879088e-26	2.3794842503e-31
C71	x ⁶ y ⁵	1.3768618594e-28	3.9992668962e-26	8.7729409191e-31
C73	x ⁴ y ⁷	1.1635579021e-28	1.5378840632e-25	1.2112308914e-30
C75	x ² y ⁹	-4.6768762716e-29	1.3470022107e-24	7.4499678049e-31
C77	y ¹¹	-1.4414536306e-29	1.9798483612e-24	1.8099433913e-31

C78	x^{12}	-6.2573622636e-32	9.6840022387e-31	4.1915134481e-35
C80	$x^{10}y^2$	-1.3705906237e-31	-2.1627131588e-29	-5.3057626425e-34
C82	x^8y^4	-1.1701207834e-30	-1.2320987581e-28	-2.2287547235e-33
C84	x^6y^6	-8.1382269072e-31	-3.0243301537e-28	-4.1583414211e-33
C86	x^4y^8	4.4593120730e-31	1.3537235795e-27	-3.5237066868e-33
C88	x^2y^{10}	2.0466652524e-31	1.2747204738e-26	-1.1994865841e-33
C90	y^{12}	3.8840349497e-33	5.9926442904e-27	-2.2221338718e-35
C92	$x^{12}y$	5.7005243953e-34	9.9015092784e-33	-3.0957933927e-37
C94	$x^{10}y^3$	3.9638927346e-33	-3.8105669740e-31	-5.0992497858e-37
C96	x^8y^5	3.2101895033e-33	-1.8952660084e-30	-2.0052445840e-36
C98	x^6y^7	-3.7245005367e-33	-7.4308159032e-30	-4.4777909769e-36
C100	x^4y^9	-2.6055880635e-33	1.2387446272e-29	-4.6096387637e-36
C102	x^2y^{11}	-2.3075372481e-34	9.9493160654e-29	-2.0864057762e-36
C104	y^{13}	1.7624892289e-35	2.8734192234e-29	-2.7804742330e-37
C105	x^{14}	3.9994949971e-37	-2.3461598956e-35	-5.0895650473e-41
C107	$x^{12}y^2$	5.4076191152e-37	6.4574876761e-35	1.3534605782e-39
C109	$x^{10}y^4$	1.1118810332e-35	4.2942578332e-33	8.8416325093e-39
C111	x^8y^6	3.2559140624e-35	2.8673320335e-32	2.4001412388e-38
C113	x^6y^8	2.0670357607e-35	-2.1991840412e-32	3.0013772158e-38
C115	x^4y^{10}	3.4244272822e-36	1.4083056638e-31	1.8018959697e-38
C117	x^2y^{12}	3.9691527754e-37	5.8340538680e-31	3.7828363842e-39
C119	y^{14}	1.4878451183e-37	1.3709170354e-31	-9.0199805810e-40
C121	$x^{14}y$	-4.3213523241e-39	1.2396051300e-37	1.6357254755e-42
C123	$x^{12}y^3$	-3.7487408487e-38	9.3145282891e-36	7.3649581384e-42
C125	$x^{10}y^5$	-1.0450728693e-37	6.8057675451e-35	2.5826640631e-41
C127	x^8y^7	-5.6766501485e-38	4.0451096046e-34	6.0129862312e-41
C129	x^6y^9	5.3027665655e-39	3.8842076952e-34	7.8946108862e-41
C131	x^4y^{11}	4.9446191449e-39	1.4032341431e-33	5.7797404833e-41
C133	x^2y^{13}	-1.7196314065e-39	2.3094763385e-33	2.2356418383e-41
C135	y^{15}	-6.0134489663e-40	4.8486471018e-34	2.9641050860e-42
C136	x^{16}	-1.5186175276e-42	2.8300687848e-40	-4.6943614205e-46
C138	$x^{14}y^2$	1.0650904384e-42	6.2369201480e-39	-9.7272328282e-45
C140	$x^{12}y^4$	-1.0807917038e-41	-5.5937407185e-38	-6.4414916805e-44
C142	$x^{10}y^6$	-1.8250235250e-40	-9.4517306458e-37	-1.9963070788e-43
C144	x^8y^8	-2.6773469853e-40	4.0008142625e-37	-3.3011761498e-43
C146	x^6y^{10}	-1.2990789110e-40	7.5040126203e-36	-3.0232075860e-43
C148	x^4y^{12}	-1.8571773748e-41	1.0603482616e-35	-1.5330362590e-43
C150	x^2y^{14}	2.9852299389e-42	5.4150048200e-36	-3.4566781760e-44
C152	y^{16}	8.1601330425e-43	1.6610541213e-36	1.9989924896e-45
C154	$x^{16}y$	1.2764893211e-44	-4.1316714265e-42	-7.0898000350e-48
C156	$x^{14}y^3$	1.2384703510e-43	-1.4289667271e-40	-4.0509877408e-47
C158	$x^{12}y^5$	6.1653990242e-43	-1.3287749077e-39	-1.3193097650e-46
C160	$x^{10}y^7$	8.2097899551e-43	-1.1041409323e-38	-3.1959838801e-46

C162	$x^8 y^9$	4.9483256526e-43	-8.2531460500e-39	-4.9263887132e-46
C164	$x^6 y^{11}$	1.5183483262e-43	8.4797298954e-38	-4.6999085380e-46
C166	$x^4 y^{13}$	1.4846166702e-44	5.6268382413e-38	-2.7071757645e-46
C168	$x^2 y^{15}$	-1.7115618922e-45	1.4165984177e-38	-9.0553625721e-47
C170	y^{17}	-3.9898569454e-46	5.5390173410e-39	-1.1297783952e-47
C171	x^{18}	0.0000000000e+00	-2.1831463451e-45	1.8005511319e-51
C173	$x^{16} y^2$	0.0000000000e+00	-1.5183464124e-43	3.3892684645e-50
C175	$x^{14} y^4$	0.0000000000e+00	-1.5714917233e-44	2.3678591193e-49
C177	$x^{12} y^6$	0.0000000000e+00	1.6429641123e-41	8.3966680622e-49
C179	$x^{10} y^8$	0.0000000000e+00	1.3825962459e-41	1.7088438276e-48
C181	$x^8 y^{10}$	0.0000000000e+00	-5.8345885452e-41	2.0978197924e-48
C183	$x^6 y^{12}$	0.0000000000e+00	6.2027082462e-40	1.5431054903e-48
C185	$x^4 y^{14}$	0.0000000000e+00	2.1860201839e-40	6.8694624354e-49
C187	$x^2 y^{16}$	0.0000000000e+00	1.0896130706e-40	1.4521537112e-49
C189	y^{18}	0.0000000000e+00	1.5536206833e-41	-2.5532307450e-51
C191	$x^{18} y$	0.0000000000e+00	4.1370971907e-47	2.0985806012e-53
C193	$x^{16} y^3$	0.0000000000e+00	1.0259243899e-45	1.4384045207e-52
C195	$x^{14} y^5$	0.0000000000e+00	1.0829939153e-44	4.8976270137e-52
C197	$x^{12} y^7$	0.0000000000e+00	1.5381284633e-43	1.2397598026e-51
C199	$x^{10} y^9$	0.0000000000e+00	2.9582332188e-43	2.1195519880e-51
C201	$x^8 y^{11}$	0.0000000000e+00	-9.9465705373e-43	2.3966288455e-51
C203	$x^6 y^{13}$	0.0000000000e+00	3.0478995293e-42	1.8045192605e-51
C205	$x^4 y^{15}$	0.0000000000e+00	7.5826692066e-43	8.5142849832e-52
C207	$x^2 y^{17}$	0.0000000000e+00	4.3510343502e-43	2.5554775815e-52
C209	y^{19}	0.0000000000e+00	4.4983426610e-44	3.2789192601e-53
C210	x^{20}	0.0000000000e+00	9.4025168781e-51	-4.8982206388e-57
C212	$x^{18} y^2$	0.0000000000e+00	1.5979992892e-48	-8.4642680532e-56
C214	$x^{16} y^4$	0.0000000000e+00	4.7951541761e-48	-6.0942213536e-55
C216	$x^{14} y^6$	0.0000000000e+00	-1.8725391845e-46	-2.3937549869e-54
C218	$x^{12} y^8$	0.0000000000e+00	-3.4522910678e-46	-5.6749442855e-54
C220	$x^{10} y^{10}$	0.0000000000e+00	6.7145285910e-46	-8.7002702399e-54
C222	$x^8 y^{12}$	0.0000000000e+00	-8.1886726797e-45	-8.5308017562e-54
C224	$x^6 y^{14}$	0.0000000000e+00	1.0625533311e-44	-5.3919378498e-54
C226	$x^4 y^{16}$	0.0000000000e+00	1.2142915895e-45	-2.2096502123e-54
C228	$x^2 y^{18}$	0.0000000000e+00	-2.6445448193e-46	-4.5639041010e-55
C230	y^{20}	0.0000000000e+00	5.1567161269e-47	-1.1458931420e-56
C232	$x^{20} y$	0.0000000000e+00	-1.8489977294e-52	-3.6684819452e-59
C234	$x^{18} y^3$	0.0000000000e+00	-6.7113312306e-52	-2.9802612500e-58
C236	$x^{16} y^5$	0.0000000000e+00	6.3665604307e-51	-1.0548900495e-57
C238	$x^{14} y^7$	0.0000000000e+00	-5.9082007882e-49	-2.7310764825e-57
C240	$x^{12} y^9$	0.0000000000e+00	-7.0984511249e-49	-4.9775424699e-57
C242	$x^{10} y^{11}$	0.0000000000e+00	1.1816874777e-47	-6.0690096296e-57
C244	$x^8 y^{13}$	0.0000000000e+00	-2.4676429338e-47	-5.2891688050e-57

C246	$x^6 y^{15}$	0.0000000000e+00	2.3676526297e-47	-3.1894928322e-57
C248	$x^4 y^{17}$	0.0000000000e+00	-1.1680856709e-47	-1.1997680633e-57
C250	$x^2 y^{19}$	0.0000000000e+00	-5.9156182754e-48	-3.4091556993e-58
C252	y^{21}	0.0000000000e+00	-4.9840929752e-49	-4.8852450262e-59
C253	x^{22}	0.0000000000e+00	-8.6018309536e-57	6.7583456543e-63
C255	$x^{20} y^2$	0.0000000000e+00	-7.5719552914e-54	1.1435056559e-61
C257	$x^{18} y^4$	0.0000000000e+00	1.2423723571e-53	8.7814602964e-61
C259	$x^{16} y^6$	0.0000000000e+00	2.2154605324e-51	3.8023936971e-60
C261	$x^{14} y^8$	0.0000000000e+00	1.0718378770e-50	1.0188585320e-59
C263	$x^{12} y^{10}$	0.0000000000e+00	1.6207410241e-50	1.8585402994e-59
C265	$x^{10} y^{12}$	0.0000000000e+00	7.5030478949e-50	2.2883849344e-59
C267	$x^8 y^{14}$	0.0000000000e+00	-1.4317313342e-50	1.8867885133e-59
C269	$x^6 y^{16}$	0.0000000000e+00	2.7060215361e-50	1.0646498615e-59
C271	$x^4 y^{18}$	0.0000000000e+00	-7.1529079167e-50	4.0499607257e-60
C273	$x^2 y^{20}$	0.0000000000e+00	-5.4986399267e-51	8.0372003795e-61
C275	y^{22}	0.0000000000e+00	-2.1987115359e-51	3.7976977375e-62
C277	$x^{22} y$	0.0000000000e+00	4.1594171074e-58	3.5821349455e-65
C279	$x^{20} y^3$	0.0000000000e+00	-1.7598285342e-56	3.4233223414e-64
C281	$x^{18} y^5$	0.0000000000e+00	-7.2367430997e-56	1.2460695752e-63
C283	$x^{16} y^7$	0.0000000000e+00	1.2828750183e-54	3.2165689750e-63
C285	$x^{14} y^9$	0.0000000000e+00	-2.0525475758e-53	6.0362047203e-63
C287	$x^{12} y^{11}$	0.0000000000e+00	-1.6182512770e-52	7.1716822438e-63
C289	$x^{10} y^{13}$	0.0000000000e+00	-6.5901384853e-53	5.7941474226e-63
C291	$x^8 y^{15}$	0.0000000000e+00	1.3795774067e-53	3.5620161540e-63
C293	$x^6 y^{17}$	0.0000000000e+00	9.8527347691e-53	1.3441795539e-63
C295	$x^4 y^{19}$	0.0000000000e+00	-6.8712074405e-53	1.6238675608e-64
C297	$x^2 y^{21}$	0.0000000000e+00	5.2529273887e-53	9.5836665918e-65
C299	y^{23}	0.0000000000e+00	-2.3540990413e-54	3.0168560979e-65
C300	x^{24}	0.0000000000e+00	-5.9600761077e-62	-4.1632164935e-69
C302	$x^{22} y^2$	0.0000000000e+00	1.0863938638e-59	-7.4193151527e-68
C304	$x^{20} y^4$	0.0000000000e+00	-4.0117982534e-58	-6.1380557517e-67
C306	$x^{18} y^6$	0.0000000000e+00	-1.5718722173e-56	-2.9000240486e-66
C308	$x^{16} y^8$	0.0000000000e+00	-1.4008357766e-55	-8.6301101146e-66
C310	$x^{14} y^{10}$	0.0000000000e+00	-6.0634631448e-55	-1.8025017378e-65
C312	$x^{12} y^{12}$	0.0000000000e+00	-1.4840722112e-54	-2.6701863663e-65
C314	$x^{10} y^{14}$	0.0000000000e+00	-1.3091733247e-54	-2.7523229011e-65
C316	$x^8 y^{16}$	0.0000000000e+00	-1.0629302071e-55	-1.9927587216e-65
C318	$x^6 y^{18}$	0.0000000000e+00	5.8613810290e-55	-1.0289816420e-65
C320	$x^4 y^{20}$	0.0000000000e+00	3.4823418947e-55	-3.6376834969e-66
C322	$x^2 y^{22}$	0.0000000000e+00	1.5803081162e-55	-6.9805336821e-67
C324	y^{24}	0.0000000000e+00	1.3772093915e-57	-4.4575627675e-68
C326	$x^{24} y$	0.0000000000e+00	-1.1110895016e-63	-1.5290482156e-71
C328	$x^{22} y^3$	0.0000000000e+00	-2.3434183181e-62	-1.5903156950e-70

C330	$x^{20}y^5$	0.0000000000e+00	-4.1697969521e-60	-5.3832975201e-70
C332	$x^{18}y^7$	0.0000000000e+00	-7.3360581606e-59	-1.1290838039e-69
C334	$x^{16}y^9$	0.0000000000e+00	-4.6620713883e-58	-1.5329526355e-69
C336	$x^{14}y^{11}$	0.0000000000e+00	-1.5035720530e-57	9.0217799998e-71
C338	$x^{12}y^{13}$	0.0000000000e+00	-2.7848666110e-57	3.9073170434e-69
C340	$x^{10}y^{15}$	0.0000000000e+00	-2.2750829395e-57	6.3530673758e-69
C342	x^8y^{17}	0.0000000000e+00	-1.5116865996e-58	5.7536054649e-69
C344	x^6y^{19}	0.0000000000e+00	9.9972805825e-58	3.6839558863e-69
C346	x^4y^{21}	0.0000000000e+00	6.8363951038e-58	1.5730396762e-69
C348	x^2y^{23}	0.0000000000e+00	1.3061391061e-58	2.9148927646e-70
C350	y^{25}	0.0000000000e+00	1.6092085911e-60	1.4331730920e-71

用於圖4的表3c

【0104】該光闌邊緣之座標

x_i [mm]	y_i [mm]	$x_{i+N/2}$ [mm]	$y_{i+N/2}$ [mm]
-367.893612	15.028813	368.008707	1.526968
-367.407246	21.811473	367.638792	-5.183369
-366.635369	28.609124	366.986046	-11.861030
-365.579212	35.416952	366.052980	-18.502010
-364.240770	42.230004	364.842783	-25.102475
-362.622783	49.043199	363.359289	-31.658752
-360.728713	55.851344	361.606936	-38.167330
-358.562717	62.649150	359.590708	-44.624845
-356.129606	69.431245	357.316093	-51.028077
-353.434805	76.192194	354.789017	-57.373934
-350.484301	82.926515	352.015789	-63.659443
-347.284593	89.628697	349.003036	-69.881740
-343.842625	96.293220	345.757639	-76.038050
-340.165735	102.914576	342.286673	-82.125682
-336.261581	109.487286	338.597335	-88.142008
-332.138082	116.005920	334.696886	-94.084461
-327.803345	122.465121	330.592587	-99.950513
-323.265608	128.859621	326.291644	-105.737673
-318.533166	135.184258	321.801149	-111.443474
-313.614316	141.433997	317.128038	-117.065468
-308.517295	147.603941	312.279044	-122.601221
-303.250227	153.689346	307.260664	-128.048307
-297.821071	159.685627	302.079129	-133.404311
-292.237581	165.588366	296.740388	-138.666825
-286.507265	171.393320	291.250091	-143.833451
-280.637356	177.096417	285.613586	-148.901808
-274.634789	182.693760	279.835921	-153.869529
-268.506179	188.181626	273.921854	-158.734272

-262.257819	193.556459	267.875861	-163.493722
-255.895668	198.814871	261.702163	-168.145599
-249.425361	203.953631	255.404740	-172.687661
-242.852209	208.969664	248.987360	-177.117711
-236.181218	213.860042	242.453604	-181.433605
-229.417101	218.621980	235.806895	-185.633249
-222.564299	223.252825	229.050522	-189.714613
-215.626999	227.750050	222.187669	-193.675724
-208.609157	232.111249	215.221442	-197.514680
-201.514524	236.334125	208.154893	-201.229641
-194.346662	240.416488	200.991040	-204.818841
-187.108973	244.356244	193.732894	-208.280582
-179.804714	248.151388	186.383472	-211.613238
-172.437025	251.800002	178.945818	-214.815255
-165.008940	255.300247	171.423017	-217.885152
-157.523409	258.650359	163.818207	-220.821518
-149.983313	261.848644	156.134590	-223.623015
-142.391478	264.893478	148.375437	-226.288373
-134.750687	267.783301	140.544103	-228.816393
-127.063692	270.516618	132.644021	-231.205947
-119.333220	273.091998	124.678710	-233.455972
-111.561985	275.508076	116.651776	-235.565473
-103.752691	277.763552	108.566909	-237.533520
-95.908038	279.857195	100.427882	-239.359251
-88.030725	281.787845	92.238545	-241.041866
-80.123451	283.554417	84.002825	-242.580631
-72.188921	285.155903	75.724719	-243.974874
-64.229844	286.591381	67.408285	-245.223988
-56.248933	287.860009	59.057639	-246.327431
-48.248905	288.961039	50.676950	-247.284721
-40.232484	289.893812	42.270428	-248.095441
-32.202396	290.657766	33.842323	-248.759240
-24.161371	291.252439	25.396915	-249.275828
-16.112140	291.677466	16.938507	-249.644980
-8.057438	291.932587	8.471424	-249.866536
0.000000	292.017645	0.000000	-249.940398
8.057438	291.932587	-8.471424	-249.866536
16.112140	291.677466	-16.938507	-249.644980
24.161371	291.252439	-25.396915	-249.275828
32.202396	290.657766	-33.842323	-248.759240
40.232484	289.893812	-42.270428	-248.095441
48.248905	288.961039	-50.676950	-247.284721
56.248933	287.860009	-59.057639	-246.327431

64.229844	286.591381	-67.408285	-245.223988
72.188921	285.155903	-75.724719	-243.974874
80.123451	283.554417	-84.002825	-242.580631
88.030725	281.787845	-92.238545	-241.041866
95.908038	279.857195	-100.427882	-239.359251
103.752691	277.763552	-108.566909	-237.533520
111.561985	275.508076	-116.651776	-235.565473
119.333220	273.091998	-124.678710	-233.455972
127.063692	270.516618	-132.644021	-231.205947
134.750687	267.783301	-140.544103	-228.816393
142.391478	264.893478	-148.375437	-226.288373
149.983313	261.848644	-156.134590	-223.623015
157.523409	258.650359	-163.818207	-220.821518
165.008940	255.300247	-171.423017	-217.885152
172.437025	251.800002	-178.945818	-214.815255
179.804714	248.151388	-186.383472	-211.613238
187.108973	244.356244	-193.732894	-208.280582
194.346662	240.416488	-200.991040	-204.818841
201.514524	236.334125	-208.154893	-201.229641
208.609157	232.111249	-215.221442	-197.514680
215.626999	227.750050	-222.187669	-193.675724
222.564299	223.252825	-229.050522	-189.714613
229.417101	218.621980	-235.806895	-185.633249
236.181218	213.860042	-242.453604	-181.433605
242.852209	208.969664	-248.987360	-177.117711
249.425361	203.953631	-255.404740	-172.687661
255.895668	198.814871	-261.702163	-168.145599
262.257819	193.556459	-267.875861	-163.493722
268.506179	188.181626	-273.921854	-158.734272
274.634789	182.693760	-279.835921	-153.869529
280.637356	177.096417	-285.613586	-148.901808
286.507265	171.393320	-291.250091	-143.833451
292.237581	165.588366	-296.740388	-138.666825
297.821071	159.685627	-302.079129	-133.404311
303.250227	153.689346	-307.260664	-128.048307
308.517295	147.603941	-312.279044	-122.601221
313.614316	141.433997	-317.128038	-117.065468
318.533166	135.184258	-321.801149	-111.443474
323.265608	128.859621	-326.291644	-105.737673
327.803345	122.465121	-330.592587	-99.950513
332.138082	116.005920	-334.696886	-94.084461
336.261581	109.487286	-338.597335	-88.142008
340.165735	102.914576	-342.286673	-82.125682

343.842625	96.293220	-345.757639	-76.038050
347.284593	89.628697	-349.003036	-69.881740
350.484301	82.926515	-352.015789	-63.659443
353.434805	76.192194	-354.789017	-57.373934
356.129606	69.431245	-357.316093	-51.028077
358.562717	62.649150	-359.590708	-44.624845
360.728713	55.851344	-361.606936	-38.167330
362.622783	49.043199	-363.359289	-31.658752
364.240770	42.230004	-364.842783	-25.102475
365.579212	35.416952	-366.052980	-18.502010
366.635369	28.609124	-366.986046	-11.861030
367.407246	21.811473	-367.638792	-5.183369
367.893612	15.028813	-368.008707	1.526968
368.093999	8.265809	-368.093999	8.265809

用於圖4的表4

【0105】 投影光學單元7之更多資料出於以下的表5：

NA	數值孔徑	0.75
$ \beta_x $	該交叉掃描方向上的放大比例	4.0
$ \beta_y $	該掃描方向上的放大比例	8.0
RMS	掃描波前偏差	8.9 mλ
N	反射鏡之數量	9

用於圖4的表5

【0106】 依據圖4的投影光學單元32具有3731 mm之物件/影像偏移a。該作業距離b係存在於物件平面5與在投影光學單元32之該情況下與其最接近的該反射鏡M5之該反射部位之間，並為275 mm。該經向橫向尺寸c係存在於分隔平面31a與在投影光學單元32之該情況下與前述分隔平面31a相距最遠的該反射鏡M9之該反射部位之間，並在投影光學單元32之該情況下為4397 mm。

【0107】 該比率a/c在投影光學單元32之該情況下為0.85。該比率b/c在投影光學單元32之該情況下為0.063。

【0108】該比率 a/c 在該等三個以上所說明投影光學單元7、31、和32之每個中皆係大於0.5。

【0109】該尺寸比率 b/c 在該等投影光學單元7、31、和32之每個中皆係大於0.05。

【0110】該等投影光學單元7、31、和32每個皆具有至少1500 mm之物件/影像偏移 a 。

【0111】該等投影光學單元7、31、和32每個皆具有至少270 mm之作業距離 b 。該等投影光學單元7、31、和32每個皆具有至多4500 mm之經向橫向尺寸。

【0112】該等投影光學單元7、31、32之重要特性係在以下在特性表中再次彙總：

投影光學單元	物件/影像偏移(mm)	作業距離(mm)	經向橫向尺寸(mm)	a/c	b/c
圖2	1650	275	2154	0.76	0.128
圖3	3468	277	4112	0.84	0.067
圖4	3731	275	4397	0.85	0.063

依據圖2、圖3、和圖4的該等投影光學單元之特性。

【0113】為了生成微結構化或奈米結構化部件，投影曝光設備1係如下使用：首先，提供反射圖罩10或該遮罩和該基板或晶圓11。其後，遮罩10上的結構係借助於投影曝光設備1投影到晶圓11之光敏層上。然後，晶圓11上的微結構或奈米結構，以及因此該微結構化部件，係藉由顯影該光敏層而生成。

【符號說明】

- 1：投影曝光設備
- 2：光源
- 3：照明光或成像光
- 4：物件場
- 5：物件平面
- 6：照明光學單元

7：成像光學單元

8：影像場

9：影像平面

10：遮罩

10a：遮罩夾

10b：遮罩移置驅動器

11：基板

12：基板夾

12a：基板移置驅動器

13、14：波束

29：個別光線

30：主光線

30a：通道開口

31、32：投影光學單元；成像光學單元

31a：分隔平面

AS：光闌

CRAO：角度

M1、M2、M3、M4、M5、M6、M7、M8、M9、M10、M11：反射鏡

【發明申請專利範圍】

【請求項1】 一種成像光學單元（7、31、32）

- 包含複數反射鏡（M1至M8、M1至M11、M1至M9），其用於將一物件平面（5）中的一物件場（4）成像到一影像平面（9）中的一影像場（8）中，
- 具有大於0.55的一影像側數值孔徑，
- 具有一物件/影像偏移 a 介於
 - 該物件場（5）之一中心位於其中並垂直於該成像光學單元（7、31、32）之一經向平面（ yz ）的一分隔平面（31a）與
 - 該影像場（8）之一中心之間，
- 具有一作業距離 b 介於
 - 該物件平面（5）與
 - 該等反射鏡（M4、M5）其中之一者之最接近於該物件平面之一反射部位之間，
- 具有一經向橫向尺寸 c 介於
 - 該分隔平面（31a）與
 - 該等反射鏡（M4、M11、M9）其中之一者之與該分隔平面（31a）相距最遠之一反射部位之間，
- 其中下列適用：
 - 該比率 a/c 為至少0.5，
 - 該比率 b/c 為至少0.05，
- 其中該作業距離 b 為至少270 mm。

【請求項2】 如請求項1之成像光學單元，其特徵在於該物件/影像偏移 a 為至少1500 mm。

【請求項3】 如請求項1或請求項2之成像光學單元，其特徵在於該作業距離 b 為至少275 mm。

【請求項4】 如請求項1至請求項3任一者之成像光學單元，其特徵在於該經向橫向尺寸c為至多4500 mm。

【請求項5】 如請求項1至請求項4任一者之成像光學單元，其特徵在於作為一漸變（anamorphic）光學單元的一具體實施例。

【請求項6】 如請求項1至請求項5任一者之成像光學單元，其特徵在於未超過20 mλ之一波前像差。

【請求項7】 如請求項1至請求項6任一者之成像光學單元，其特徵在於該等反射鏡（M1至M8、M1至M11、M1至M9）總共至少八個。

【請求項8】 如請求項1至請求項7任一者之成像光學單元，其特徵在於至少四個GI反射鏡。

【請求項9】 如請求項1至請求項8任一者之成像光學單元，其特徵在於至少三個NI反射鏡。

【請求項10】 一種光學系統

- 包含如請求項1至請求項9任一者的一成像光學單元，及
- 包含一照明光學單元（6），其用於採用照明與成像光（3）照明該物件場（4）。

【請求項11】 一種照明系統包含如請求項10的一光學系統並包含一EUV光源（2），其用於生成該照明與成像光（3）。

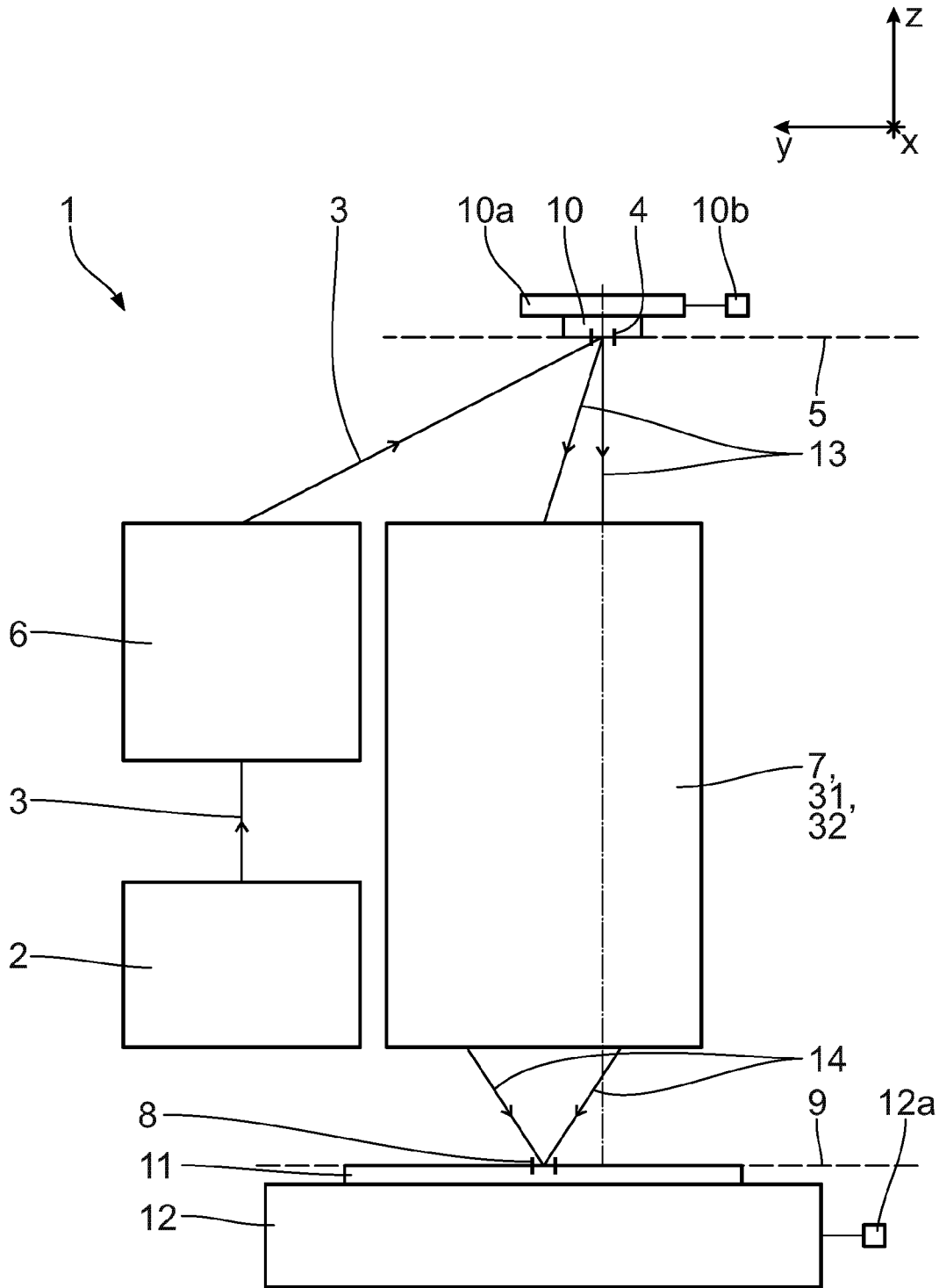
【請求項12】 一種用於投影微影的投影曝光設備（50），包含如請求項11的一照明系統。

【請求項13】 一種用於生成一結構化部件的方法，包含下列方法步驟：

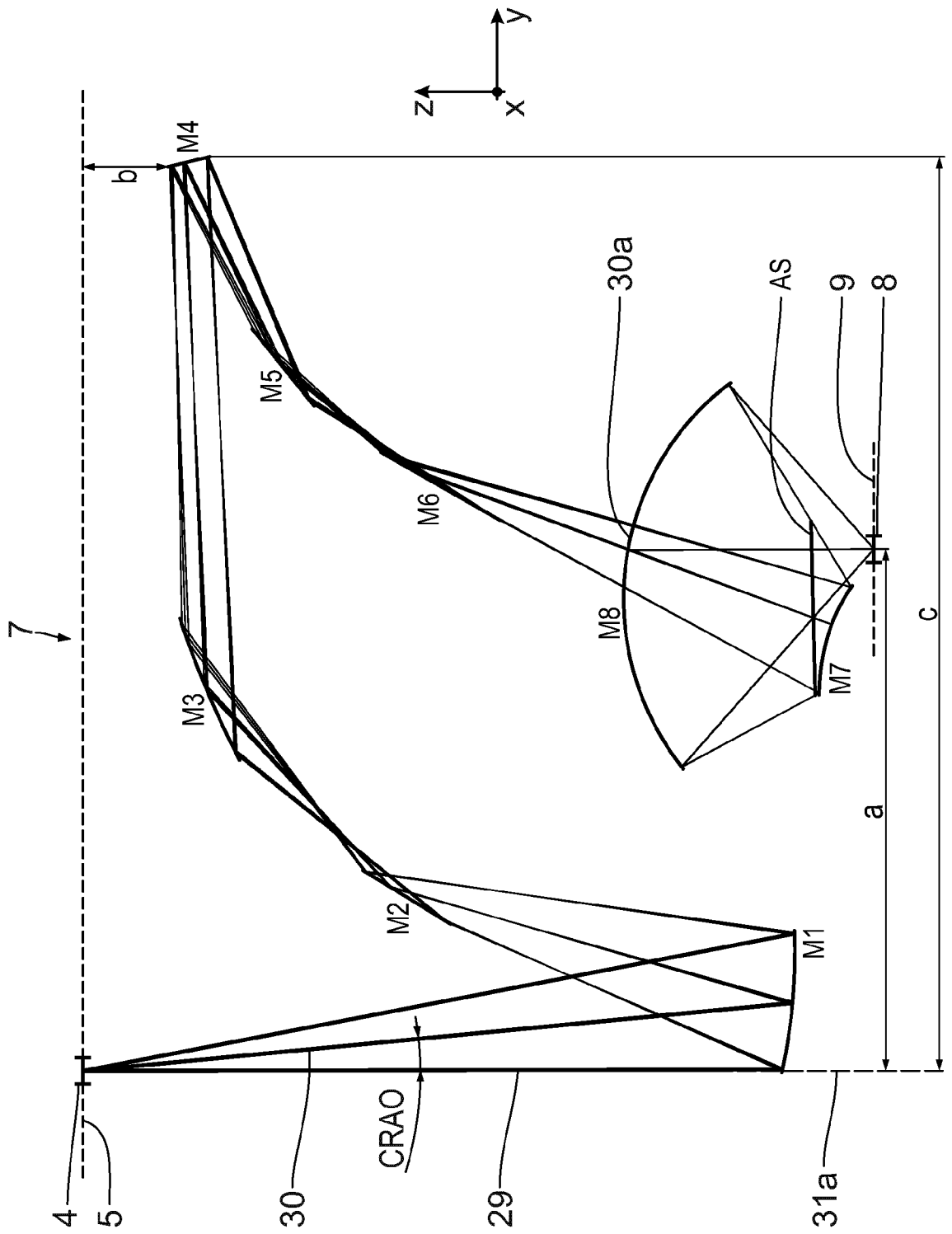
- 提供一遮罩（10）和一晶圓（11），
- 借助於如請求項12之投影曝光設備將該遮罩（10）上的一結構投影到該晶圓（11）之一光敏層上，
- 在該晶圓（11）上生成一微結構及/或一奈米結構。

【請求項14】 一種結構化部件，依據如請求項13之方法所生成。

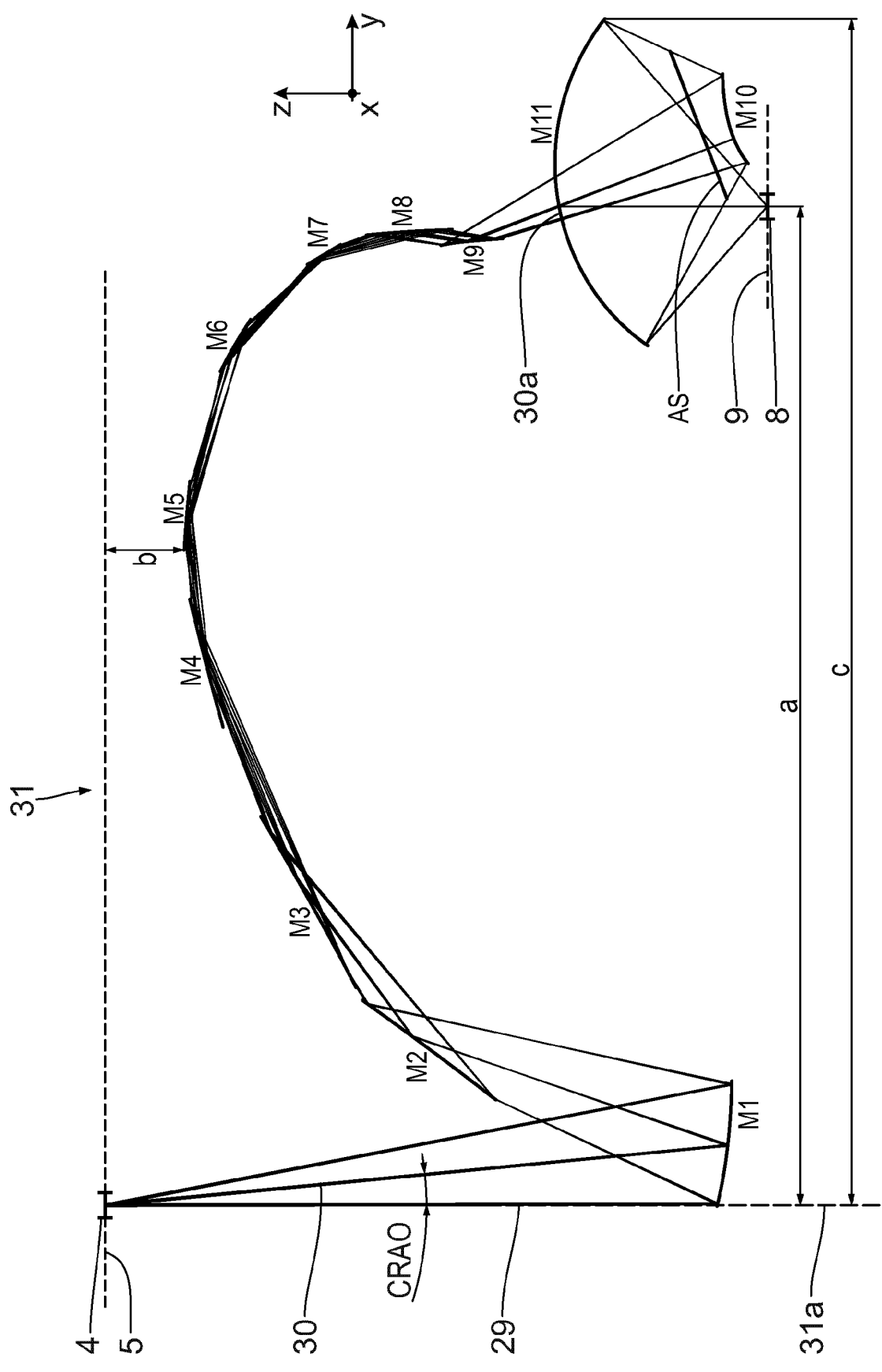
【發明圖式】



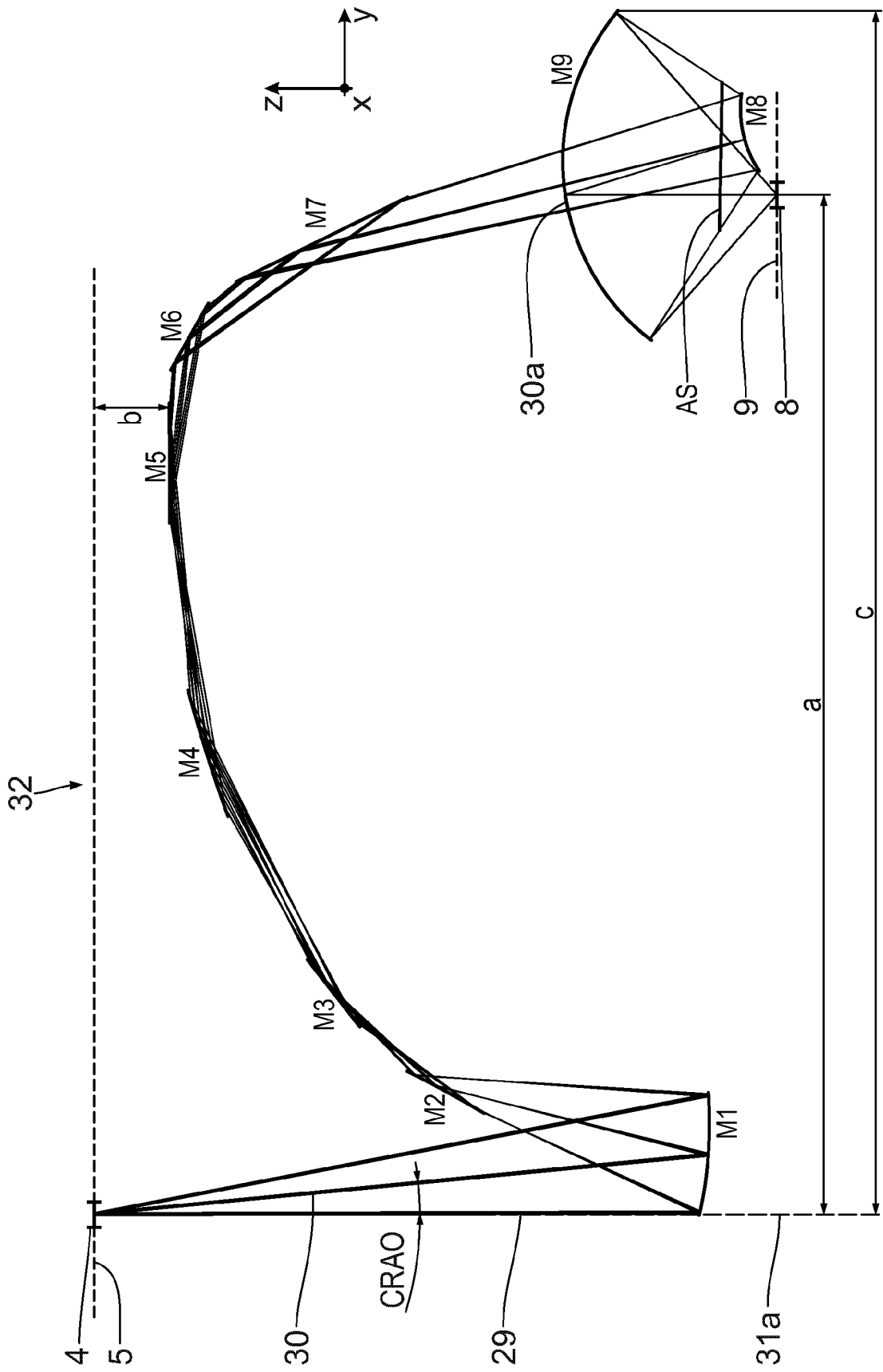
【圖1】



【圖2】



【圖3】



【圖4】