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(54) Title: SOLID FORMS OF A PHARMACEUTICALLY ACTIVE SUBSTANCE

(57) Abstract: The present invention provides solid forms of the compound of formula 1 and pharmaceutical uses thereof. (I)

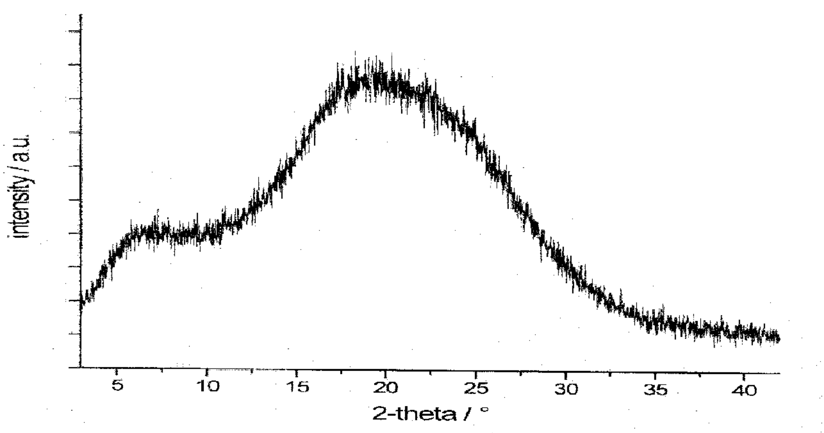
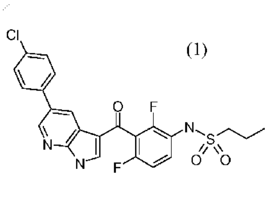


Fig. 1



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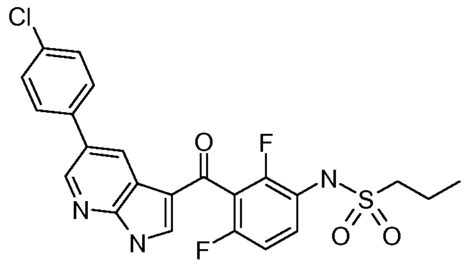
SOLID FORMS OF A PHARMACEUTICALLY ACTIVE SUBSTANCE

[0001] The present invention relates to various forms and formulations of compounds, for example, compounds that have use in pharmaceutical applications.

[0002] The compound Propane-1-sulfonic acid {3-[5-(4-chloro-phenyl)-1H-pyrrolo[2,3-b]pyridine-3-carbonyl]-2,4-difluoro-phenyl}-amide (compound 1) is represented by formula 1:



(1).

[0003] The compound of formula 1 has been described in WO 2007002433 and WO 2007002325. The crystalline forms 1 and 2 (also I and II), the amorphous form, as well as the tosylate and mesylate salt of compound 1 are disclosed in International Application No. PCT/US10/29489.

[0004] Active pharmaceutical ingredients (API's) may be prepared in a variety of different forms, such as for example salts, solvates, hydrates, co-crystals. API's may also be in their amorphous state or one or several crystalline forms (polymorphs). Depending on the form, the physicochemical properties of an API may change, leading to e.g. different solubility, thermodynamic stability, density or melting point of different forms. Such physicochemical properties therefore may have significant influence of the efficacy or bioavailability of a known API.

Summary of the Invention

[0005] The present invention provides solid forms of the compound of formula 1 selected from the group consisting of:

a) a substantially amorphous form of compound 1, selected from form XVII, XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV, XXVI or combinations thereof, wherein compound 1 is molecularly dispersed;
b) a solvate of form III, IV, V, VI, VII, IX, X, XI, XII, XIII, XIV, or XV;
c) a polymorph of form VIII or XVI; and
d) the sulfuric acid-, hydrobromic acid- or hydrochloric acid salt of compound 1.

[0006] In one particular embodiment, said solid form is selected from a solvate of form III, IV, V, VI, VII, IX, X, XI, XII, XIII, XIV or XV.

[0007] In another particularly preferred embodiment, said solid form is selected from a polymorph of form VIII or XVI.

[0008] In yet another preferred embodiment, said solid form is selected from the sulfuric acid-, hydrobromic acid- or hydrochloric acid salt of compound 1.

[0009] In still another preferred embodiment, said solid form is a substantially amorphous form of compound 1, selected from form XVII, XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV or XXVI or combinations thereof, wherein compound I is molecularly dispersed.

[0010] In another embodiment, the invention provides a method for treating a disease or condition in a mammal in need thereof. The method includes administering to the mammal an effective amount of a composition comprising a solid form compound as described herein. In certain embodiments, the diseases or conditions are mediated by b-Raf mutants having V600E, V600M, V600R, V600K or V600G mutations. In other embodiments, the diseases or conditions include, but are not limited to melanoma, thyroid cancer and colorectal cancer.

[0011] The solid forms disclosed herein may be further processed into any type of solid pharmaceutical preparations or dosage forms, which are known to the person of skill in the art. Particularly preferred are oral dosage forms such as tablets, capsules, pills, powders, suspensions, pasts and the like. Detailed descriptions of suitable excipients as well as methods for making such pharmaceutical preparations can for example be found in: Raymond C. Rowe et al, *Handbook of Pharmaceutical Excipients, 6th edition*, 2009, Pharmaceutical Press (Publ.); ISBN-10: 0853697922.

[0012] Consequently, so obtained pharmaceutical preparations form further embodiments provided herein.

Brief Description of the Figures

[0013] Figure 1 shows XRPD patterns of the amorphous form of compound 1 as obtainable by the method disclosed in Example 1.

[0014] Figure 2 shows the XRPD patterns of form III of compound 1 as obtained by the method disclosed in Example 3.

[0015] Figure 3 shows the XRPD patterns of form IV of compound 1 as obtained by the method disclosed in Example 4.

[0016] Figure 4 shows the XRPD patterns of form V of compound 1 as obtained by the method disclosed in Example 5.

[0017] Figure 5 shows the XRPD patterns of form VI of compound 1 as obtained by the method disclosed in Example 6.

[0018] Figure 6 shows the XRPD patterns of form VII of compound 1 as obtained by the method disclosed in Example 7.

[0019] Figure 7 shows the XRPD patterns of form VIII of compound 1 as obtained by the method disclosed in Example 8.

[0020] Figure 8 shows the XRPD patterns of form IX of compound 1 as obtained by the method disclosed in Example 9.

[0021] Figure 9 shows the XRPD patterns of form X of compound 1 as obtained by the method disclosed in Example 10.

[0022] Figure 10 shows the XRPD patterns of form XI of compound 1 as obtained by the method disclosed in Example 11.

[0023] Figure 11 shows the XRPD patterns of form XII of compound 1 as obtained by the method disclosed in Example 12.

[0024] Figure 12 shows the XRPD patterns of form XIII of compound 1 as obtained by the method disclosed in Example 13.

[0025] Figure 13 shows the XRPD patterns of form XIV of compound 1 as obtained by the method disclosed in Example 14.

[0026] Figure 14 shows the XRPD patterns of form XV of compound 1 as obtained by the method disclosed in Example 15.

[0027] Figure 15 shows the Raman spectrum of form XVI of compound 1 as obtained by the method disclosed in Example 16.

[0028] Figure 16 shows the XRPD patterns of pattern 6 of compound 1 as obtained by the method disclosed in Example 17.

[0029] Figure 17 shows the XRPD patterns of sulfuric acid salt of compound 1 as obtained by the method disclosed in Example 18.

[0030] Figure 18 shows the XRPD patterns of hydrobromic acid salt of compound 1 as obtained by the method disclosed in Example 19.

[0031] Figure 19 shows the XRPD patterns of hydrochloric acid salt of compound 1 as obtained by the method disclosed in Example 20.

[0032] Figure 20 shows the XRPD patterns of form XVII of compound 1 as obtained by the method disclosed in Examples 21 and 22.

[0033] Figure 21 shows the XRPD patterns of form XVIII of compound 1 as obtained by the method disclosed in Examples 21 and 22.

[0034] Figure 22 shows the XRPD patterns of form XIX of compound 1 as obtained by the method disclosed in Examples 21 and 22.

[0035] Figure 23 shows the XRPD patterns of form XX of compound 1 as obtained by the method disclosed in Examples 21 and 22.

[0036] Figure 24 shows the XRPD patterns of form XXI of compound 1 as obtained by the method disclosed in Examples 21 and 22.

[0037] Figure 25 shows the XRPD patterns of form XXII of compound 1 as obtained by the method disclosed in Examples 21 and 22.

[0038] Figure 26 shows the XRPD patterns of form XXIII of compound 1 as obtained by the method disclosed in Examples 21 and 22.

[0039] Figure 27 shows the XRPD patterns of form XXIV of compound 1 as obtained by the method disclosed in Examples 21 and 22.

[0040] Figure 28 shows the XRPD patterns of form XXV of compound 1 as obtained by the method disclosed in Examples 21 and 22.

[0041] Figure 29 shows the XRPD patterns of form XXVI of compound 1 as obtained by the method disclosed in Examples 21 and 22.

Detailed Description of the Invention

Definitions

[0042] The term "compound 1" as used herein means Propane-1-sulfonic acid {3-[5-(4-chloro-phenyl)-1H-pyrrolo[2,3-b]pyridine-3-carbonyl]-2,4-difluoro-phenyl}-amide, which is sometimes also designated as PLX-4032.

[0043] As used herein, the general term "amorphous forms" denotes a material that lacks long range order and as such does not show sharp X-ray peaks. The X-Ray Powder Diffraction (XRPD) pattern of an amorphous material is characterized by one or more amorphous halos. More specifically, the term "amorphous form" as used herein refers to the amorphous form of Propane-1-sulfonic acid {3-[5-(4-chloro-phenyl)-1H-pyrrolo[2,3-b]pyridine-3-carbonyl]-2,4-difluoro-phenyl}-amide (compound 1) *as such*, provided said amorphous form does not form a one phase system, such as for example a solid dispersion or microprecipitated bulk powder (MBP) together with any type of supporting material such as polymers or the like.

[0044] The term "amorphous halo" means a broad diffraction maximum in the X-ray powder diffraction pattern of an amorphous substance, i.e. the amorphous form of compound 1. The FWHM (full width at half maximum) of an amorphous halo is usually bigger than two degrees in 2-theta.

[0045] The “Form II” of compound 1 as referred to herein means the thermodynamically stable form of Propane-1-sulfonic acid {3-[5-(4-chloro-phenyl)-1H-pyrrolo[2,3-b]pyridine-3-carbonyl]-2,4-difluoro-phenyl}-amide.

[0046] The term “molecularly dispersed”, as used herein, refers to the random distribution of compound 1 within a polymer. More particularly, a compound (for example, compound 1) may be dispersed within a matrix formed by the polymer in its solid state such that the compound 1 and the matrix form a one phase system (solid dispersion) and compound 1 is immobilized in its amorphous form. An example of such solid dispersion is a micro-precipitated bulk powder (MBP). Whether a compound is molecularly dispersed in a polymer may be evidenced in a variety of ways, e.g., by the resulting solid molecular complex having a single glass transition temperature.

[0047] The term “flash cooling” as used herein means cooling with liquid nitrogen.

[0048] The term “approximately“ in connection with the XRPD patterns as disclosed herein means that there is an uncertainty in the measurements of the degrees 2Theta of ± 0.2 degrees (expressed in degrees 2Theta).

[0049] The term “polymorph” as used herein means one of the different crystal structures in which a compound can crystallize. Polymorphs are best characterized by their space group and unit-cell parameters. This term is reserved for materials with the same elemental analysis.

[0050] The term “solvate” as used herein means a crystal form that contains either stoichiometric or nonstoichiometric amounts of solvent.

[0051] The term “substantially amorphous” material embraces material which has no more than about 10% crystallinity; and “amorphous” material embraces material which has no more than about 2% crystallinity. In some embodiments, the “amorphous” material means material having no more than 1%, 0.5% or 0.1 % crystallinity.

[0052] “Ambient temperature” means any temperature in the range of 18 to 28 °C, preferably 20 to 24 °C.

[0053] The term “composition” refers to a pharmaceutical preparation suitable for administration to an intended animal subject for therapeutic purposes that contains at least one pharmaceutically active compound, including any solid form thereof. The composition may include at least one additional pharmaceutically acceptable component to provide an improved formulation of the compound, such as a suitable carrier, additive or excipient.

[0054] The term "pharmaceutically acceptable" indicates that the indicated material does not have properties that would cause a reasonably prudent medical practitioner to avoid administration of the material to a patient, taking into consideration the disease or conditions to be treated and the respective route of administration. For example, it is commonly required that such a material be essentially sterile, e.g., for injectibles.

[0055] The term "therapeutically effective" or "effective amount" indicates that the materials or amount of material is effective to prevent, alleviate, or ameliorate one or more symptoms of a disease or medical condition, and/or to prolong the survival of the subject being treated. In certain embodiments, a "therapeutically-effective amount" of Compound I refers to such dosages and/or administration for such periods of time necessary to inhibit human b-Raf containing the V600E mutation. In some embodiments, the human b-Raf includes V600A, V600M, V600R, V600K or V600G mutations. Moreover, a therapeutically effective amount may be one in which the overall therapeutically-beneficial effects outweigh the toxic or undesirable side effects. A therapeutically-effective amount of Compound I may vary according to disease state, age and weight of the subject being treated. Thus, dosage regimens are typically adjusted to the individual requirements in each particular case and are within the skill in the art. In certain embodiments, an appropriate daily dose for administration of Compound 1 to an adult human may be from about 100 mg to about 3200 mg; or from about 250 mg to about 2000 mg, although the upper limit may be exceeded when indicated. A daily dosage of Compound 1 can be administered as a single dose, in divided doses, or, for parenteral administration, it may be given as subcutaneous injection.

[0056] In the spray dry dispersion process, Compound 1 and a polymer may be dissolved in a common solvent having a low boiling point, e.g., ethanol, methanol, acetone, etc. By means of spray drying or lyophilization, the solvent is evaporated by flash evaporation at the temperature close to boiling point or under a high vacuum (low vapor pressure), leaving the Compound 1 precipitated in a matrix formed by the polymer. In certain embodiments Compound 1 is in a mesylate or tosylate salt form, and thus preferably has improved solubility.

[0057] The term “methacrylic acid copolymers” as used herein in the spray dry dispersion process includes, but are not limited to, methacrylic acid copolymers, methacrylic acid - methacrylate copolymers, methacrylic acid - ethyl acrylate copolymers, ammonio methacrylate copolymers, aminoalkyl methacrylate copolymers and the like. In certain embodiments, a “methacrylic acid copolymer” may be EUDRAGIT® L 100 and EUDRAGIT® L 12,5 (also referred to as, or conforms with: “Methacrylic Acid Copolymer, Type A;” “Methacrylic Acid - Methyl Methacrylate Copolymer (1:1);” “Methacrylic Acid Copolymer L;” “DMF 1242” or “PR-MF 6918”); EUDRAGIT® S 100 and EUDRAGIT® S 12,5 (also referred to as, or conforms with: “Methacrylic Acid Copolymer, Type B;” “Methacrylic Acid - Methyl Methacrylate Copolymer (1:2);” “Methacrylic Acid Copolymer S;” “DMF 1242” or “PR-MF 6918”); EUDRAGIT® L 100-55 (also referred to as, or conforms with: “Methacrylic Acid Copolymer, Type C;” “Methacrylic Acid - Ethyl Acrylate Copolymer (1:1) Type A;” “Dried Methacrylic Acid Copolymer LD;” or “DMF 2584”); EUDRAGIT® L 30 D-55 (also referred to as, or conforms with: "Methacrylic Acid Copolymer Dispersion;" "Methacrylic Acid - Ethyl Acrylate Copolymer (1:1) Dispersion 30 Per Cent;” “Methacrylic Acid Copolymer LD;” JPE DMF 2584; PR-MF 8216); EUDRAGIT® FS 30 D (also referred to as DMF 13941 or DMF 2006-176); EUDRAGIT® RL 100 (also referred to as, or conforms with: “Ammonio Methacrylate Copolymer, Type A;” “Ammonio Methacrylate Copolymer (Type A);” “Aminoalkyl Methacrylate Copolymer RS;” “DMF 1242” or “PR-MF 6918”); EUDRAGIT® RL PO (also referred to as, or conforms with: “Ammonio Methacrylate Copolymer, Type A;” "Ammonio Methacrylate Copolymer (Type A);" "Aminoalkyl Methacrylate Copolymer RS;" “DMF 1242”); EUDRAGIT® RL 12,5 (also referred to as, or conforms with “Ammonio Methacrylate Copolymer, Type A;” “Ammonio Methacrylate Copolymer (Type A);” “DMF 1242” or “PR-MF 6918”); EUDRAGIT® L 100-55 (also referred to as, or conforms with: “Methacrylic Acid Copolymer, Type C;” “Methacrylic Acid - Ethyl Acrylate Copolymer (1:1) Type A;” “Dried Methacrylic Acid Copolymer LD;” “DMF 2584”); EUDRAGIT® L 30 D-55 (also referred to as, or conforms with: "Methacrylic Acid Copolymer Dispersion" NF “Methacrylic Acid - Ethyl Acrylate Copolymer (1:1) Dispersion 30 Per Cent;” "Methacrylic Acid Copolymer LD;” “DMF 2584” or “PR-MF 8216”); EUDRAGIT® FS 30 D (also referred to as, or conforms with: “DMF 13941” or “DMF 2006-176”); EUDRAGIT® RL 100 (also referred to as, or conforms with: “Ammonio Methacrylate Copolymer, Type A;” “Ammonio Methacrylate Copolymer (Type A);” “Aminoalkyl Methacrylate Copolymer RS;” “DMF 1242;” or “PR-MF 6918”); EUDRAGIT® RL PO (also referred to as, or conforms with: "Ammonio Methacrylate

Copolymer, Type A;" "Ammonio Methacrylate Copolymer (Type A);" "Aminoalkyl Methacrylate Copolymer RS;" or "DMF 1242"); EUDRAGIT® RL 12,5 (also referred to as, or conforms with: polymer conforms to "Ammonio Methacrylate Copolymer, Type A;" "Ammonio Methacrylate Copolymer (Type A);" "DMF 1242" or "PR-MF 6918"); EUDRAGIT® RL 30 D (also referred to as, or conforms with: "Ammonio Methacrylate Copolymer Dispersion, Type A;" "Ammonio Methacrylate Copolymer (Type A);" or "DMF 1242"); EUDRAGIT® RS 100 (also referred to as, or conforms with: "Ammonio Methacrylate Copolymer, Type B;" NF "Ammonio Methacrylate Copolymer (Type B);" "Aminoalkyl Methacrylate Copolymer RS;" "DMF 1242" or "PR-MF 6918"); EUDRAGIT® RS PO (also referred to as, or conforms with: "Ammonio Methacrylate Copolymer, Type B;" "Ammonio Methacrylate Copolymer (Type B);" "Aminoalkyl Methacrylate Copolymer RS;" or "DMF 1242"); EUDRAGIT® RS 12,5 (also referred to as, or conforms with: "Ammonio Methacrylate Copolymer, Type B;" NF polymer conforms to "Ammonio Methacrylate Copolymer (Type B);" "DMF 1242" or "PR-MF 6918"); EUDRAGIT® RS 30 D (also referred to as, or conforms with: "Ammonio Methacrylate Copolymer Dispersion, Type B;" NF polymer conforms to "Ammonio Methacrylate Copolymer (Type B);" or "DMF 1242"); EUDRAGIT® E 100 (also referred to as, or conforms with: "Amino Methacrylate Copolymer;" NF "Basic Butylated Methacrylate Copolymer;" "Aminoalkyl Methacrylate Copolymer E;" "DMF 1242" or "PR-MF 6918"); EUDRAGIT® E PO (also referred to as, or conforms with: "Basic Butylated Methacrylate Copolymer;" "Aminoalkyl Methacrylate Copolymer E;" "Amino Methacrylate Copolymer;" "DMF 1242"); EUDRAGIT® E 12,5 (also referred to as, or conforms with: "Amino Methacrylate Copolymer;" "Basic Butylated Methacrylate Copolymer;" "DMF 1242" or "PR-MF 6918"); EUDRAGIT® NE 30 D (also referred to as, or conforms with: "Ethyl Acrylate and Methyl Methacrylate Copolymer Dispersion;" "Polyacrylate Dispersion 30 Per Cent;" ("Poly(ethylacrylat-methylmethacrylat)-Dispersion 30 %"); "Ethyl Acrylate Methyl Methacrylate Copolymer Dispersion;" "DMF 2822" or "PR-MF 6918"); EUDRAGIT® NE 40 D (also referred to as, or conforms with: DMF 2822); EUDRAGIT® NM 30 D (also referred to as "Polyacrylate Dispersion 30 Per Cent;" "(Poly(ethylacrylat-methylmethacrylat)-Dispersion 30 %);" or "DMF 2822"; PLASTOID® B (also referred to as, or conforms with: "DMF 12102"), or the like.

[0058] The term "API" as used herein means active pharmaceutical ingredient.

[0059] The term "DSC" as used herein means Differential Scanning Calorimetry.

[0060] The term “DVS” as used herein means Dynamic Vapor Sorption.

[0061] The term “IR” as used herein means Infra Red spectroscopy.

[0062] The term “Raman” as used herein means Raman spectroscopy.

[0063] The term “XRPD” as used herein means X-Ray Powder Diffraction.

[0064] The term “TGA” as used herein means ThermoGravimetric Analysis.

<u>Characterization Methods</u>

[0065] DSC curves were recorded using a Mettler-Toledo™ differential scanning calorimeter DSC820, DSC821 or DSC 1 with a FRS05 sensor. System suitability tests were performed with Indium as reference substance and calibrations were carried out using Indium, Benzoic acid, Biphenyl and Zinc as reference substances.

[0066] For the measurements, approximately 2 - 6 mg of sample were placed in aluminum pans, accurately weighed and hermetically closed with perforation lids. Prior to measurement, the lids were automatically pierced resulting in approx. 1.5 mm pin holes. The samples were then heated under a flow of nitrogen of about 100 mL/min using heating rates of usually 10 K/min.

[0067] TGA analysis was performed on a Mettler-Toledo™ thermogravimetric analyzer (TGA850 or TGA851). System suitability tests were performed with Hydranal as reference substance and calibrations using Aluminum and Indium as reference substances.

[0068] For the thermogravimetric analyses, approx. 5 10 mg of sample were placed in aluminum pans, accurately weighed and hermetically closed with perforation lids. Prior to measurement, the lids were automatically pierced resulting in approx. 1.5 mm pin holes. The samples were then heated under a flow of nitrogen of about 50 mL/min using a heating rate of 5 K/min.

[0069] DVS isotherms were collected on a DVS-1 (SMS Surface Measurements Systems) moisture balance system. The sorption/desorption isotherms were measured stepwise in a range of 0% RH to 90% RH at 25 °C. A weight change of <0.002 mg/min was chosen as criterion to switch to the next level of relative humidity (with a maximum equilibration time of six hours, if the weight criterion was not met). The data were corrected for the initial moisture content of the samples; that is, the weight after drying the sample at 0% relative humidity was taken as the zero point.

[0070] **IR spectra** were recorded as film of a Nujol suspension of approximately 5 mg of sample and few Nujol between two sodium chloride plates, with an FTIR spectrometer in transmittance. The Spectrometer is a Nicolet™ 20SXB or equivalent (resolution 2 cm-1, 32 or more coadded scans, MCT detector).

[0071] **Raman spectra** were recorded in the range of 150-1800 cm^{-1} at excitation of 785 nm with an ARAMIS (HoribaJobinYvon) Raman microscope equipped with a Peltier cooled CCD detector, and a 1200 l/mm grating.

[0072] **X-ray powder diffraction** patterns were recorded at ambient conditions in transmission geometry with a STOE STADIP diffractometer (Cu Kα radiation, primary monochromator, position sensitive detector, angular range 3° to 42° 2Theta, approximately 60 minutes total measurement time). Approximately 25 mg of sample were prepared and analyzed without further processing (e.g. grinding or sieving) of the substance. Alternatively, X-ray diffraction patterns were measured on a Scintag X1 powder X-ray diffractometer equipped with a sealed copper Kα1 radiation source. The samples were scanned from 2° to 36° 2θ at a rate of 1° per minute with incident beam slit widths of 2 and 4 mm and diffracted beam slit widths of 0.3 and 0.2 mm.

[0073] The amorphous form of compound I according to the present invention is preferentially substantially pure, meaning the amorphous form includes less than about 15%, preferably less than about 10%, preferably less than about 5%, preferably less than about 1%, even more preferably less than 0.1% by weight of impurities, including other polymorph forms of compound 1. In some embodiments, at least about 30-99% by weight of the total of compound 1 in the composition is present as the amorphous form. In further embodiments, at least about 70%, at least about 80%, at least about 90%, at least about 99% or at least about 99.9% by weight of the total of compound 1 in the composition is present as the amorphous form. Also provided by the invention are compositions consisting essentially of compound 1 wherein at least about 97-99% by weight of the compound 1 is present in the composition as an amorphous form, a polymorph form, a solvate form as described herein or combinations thereof.

[0074] The polymorph, solvate or amorphous form of compound I according to the present invention can also be present in mixtures. In some embodiments, amorphous form XVII can be present in mixtures with one or more other amorphous forms selected from XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV or XXVI. Solvate form III can be present in mixtures with one or more solvate forms selected from IV, V, VI, VII, IX, X, XI, XII, XIII, XIV or XV. Polymorph form VIII can be present in a mixture with polymorph form XVI.

[0075] Suitable solvents for preparation of spray dry dispersion amorphous forms of compound 1 include, but are not limited to acetone, water, alcohols, mixtures thereof, and the like. The alcohols include, but are not limited to, ethanol, methanol, isopropanol and mixtures thereof.

[0076] The solid forms of compound 1 as disclosed herein can be used in a wide variety of preparations for administration of drugs, and in particular for oral dosage forms. Exemplary dosage forms include powders or granules that can be taken orally either dry or reconstituted by addition of water to form a paste, slurry, suspension or solution; tablets, capsules, or pills. Various additives can be mixed, ground or granulated with the solid dispersion as described herein to form a material suitable for the above dosage forms. Potentially beneficial additives may fall generally into the following classes: other matrix materials or diluents, surface active agents, drug complexing agents or solubilizers, fillers, disintegrants, binders and lubricants. With respect to the solvates and polymorphs as disclosed herein, pH modifiers (e.g., acids, bases, or buffers) may also be added. Examples of other matrix materials, fillers, or diluents include lactose, mannitol, xylitol, microcrystalline cellulose, calcium diphosphate, and starch. Examples of surface active agents include sodium lauryl sulfate and polysorbate 80. Examples of drug complexing agents or solubilizers include the polyethylene glycols, caffeine, xanthene, gentisic acid and cylodextrins. Examples of disintegrants include sodium starch gycolate, sodium alginate, carboxymethyl cellulose sodium, methyl cellulose, and croscarmellose sodium. Examples of binders include methyl cellulose, microcrystalline cellulose, starch, and gums such as guar gum, and tragacanth. Examples of lubricants include magnesium stearate and calcium stearate. Examples of pH modifiers include acids such as citric acid, acetic acid, ascorbic acid, lactic acid, aspartic acid, succinic acid, phosphoric acid, and the like; bases such as sodium acetate, potassium acetate, calcium oxide, magnesium oxide, trisodium phosphate, sodium hydroxide, calcium hydroxide, aluminum hydroxide, and the like, and buffers generally comprising mixtures of acids and the salts of said acids. At least one function of inclusion of such pH modifiers is to control the dissolution rate of the drug, matrix polymer, or both, thereby controlling the local drug concentration during dissolution.

[0077] In addition to the above additives or excipients, use of any conventional materials and procedures for formulation and preparation of oral dosage forms using the compositions disclosed herein known by those skilled in the art are potentially useful. For example, the skilled artisans may formulate the compositions in an appropriate manner, and in accordance with accepted practices, such as those described in Remington's Pharmaceutical Sciences (Gennaro, Ed., Mack Publishing Co., Pa. 1990).

[0078] Consequently, a further embodiment includes a pharmaceutical preparation containing the solid dispersion as obtained by a method as described herein.

[0079] In certain embodiments, the present invention provides a method for preparing a substantially amorphous form of compound (1), the amorphous form is selected from form XVII, XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV or XXVI or combinations thereof. The method includes preparing a spray dry dispersion solution of compound (1) and drying the dispersion solution of compound (1) under conditions sufficient to obtain the amorphous form XVII, XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV or XXVI or combinations thereof. In one embodiment, the spray dry dispersion solution is dried under vacuum. In one embodiment, a spray dry dispersion solution is prepared by dispersing a solution of compound (1) into a polymer solution under conditions sufficient to obtain the spray dry dispersion solution. Any solvents or a mixture of solvents that are suitable to dissolve compound (1) can be used. Exemplary solvents for dissolving compound (1) include , but are not limited to, tetrahydrofuran (THF), acetone, acetonitrile, benzene, ethanol, toluene, ether, ethyl acetate, dimethylformamide (DMF), dimethyl sulfoxide (DMSO) or a mixture of any two or more thereof. In certain instances, an acid, such as hydrochloric acid, sulfuric acid or nitric acid is added into an organic solvent system in a ratio sufficient to assist the dissolution of compound (1). The polymer solution can be prepared by dissolving a polymer in an organic solvent or a mixture of solvents with a suitable ratio. In certain instances, the polymer is dissolved in a solvent or a mixture of solvents at a temperature ranging from 20 - 100 °C, 30-50 °C or 40-100 °C. Any polymers as described herein can be used for the preparation of the polymer solution. Exemplary solvents for preparing the polymer solution include, but are not limited to THF, acetone, acetonitrile, benzene, ethanol, toluene, ether, ethyl acetate, DMF, DMSO, H_2O or a mixture threof.

[0080] In certain embodiments, the invention provides a method for treating a disease or condition in a mammal in need thereof, said method comprising administering to said mammal an effective amount of a composition comprising at least one solid form of compound I selected from the group consisting of:

a) a substantially amorphous form of compound 1, selected from form XVII, XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV, XXVI or combinations thereof, wherein compound 1 is molecularly dispersed;
b) a solvate of form III, IV, V, VI, VII, IX, X, XI, XII, XIII, XIV, or XV;
c) a polymorph of form VIII or XVI; and
d) the sulfuric acid-, hydrobromic acid- or hydrochloric acid salt of compound 1.

[0081] In certain embodiments, the disease or condition for which the above-described method is employed is melanoma, thyroid cancer or colon cancer.

[0082] In certain embodiments, the invention provides a method for treating a disease or condition in a mammal in need thereof, said method comprising administering to said mammal an effective amount of a composition comprising at least one solid form of compound I as described herein.

[0083] In certain embodiments, the disease or condition for which the above-described method is employed is melanoma, thyroid cancer or colon cancer.

Examples

Example 1 (Reference Example)

Preparation of amorphous form of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide} (compound 1)

[0084] Amorphous material can be generally obtained by flash cooling of a melt and spray drying. Other processes such as for example lyophilization may also be used.

a) Preparation of amorphous material by spray drying

[0085] 5.0 g of compound 1 were dissolved in 150 g of tetrahydrofuran (THF) at ambient temperature. The solution was filtered via a 5 μm filter. The clear solution was spray dried using a Buechi spray-dryer (model B290) using the following parameters:

Air flow inlet [m3/h]	40
Air inlet temperature [°C]	100
Solvent flow [%]	20
Spray drying flow [%]	100
Condensator [°C]	-10

Yield: 2.8 g (56 %) amorphous compound 1.

b) Preparation of amorphous material by flash cooling of a melt

[0086] 2 g of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide} were heated to 300 °C in a stainless steel pan on a heating plate. Additionally, the material was heated using a heat gun. After obtaining a complete melt the pan was submerged into liquid nitrogen. After 10 min. the pan was removed and put into a desiccator for 48 h. For better handling, the glassy material was crushed using a mortar.

c) Characterization of the amorphous form

[0087] The amorphous form can be characterized by the lack of sharp X-ray diffraction peaks in its XRPD pattern, as well as a glass transition temperature as obtainable via DSC measurement in the range of about 100 °C to 110 °C. The exact glass transition temperature is largely dependent on the water/solvent content. Figure 1 shows XRPD patterns of the amorphous form of compound 1 as obtainable by the method disclosed in this example.

Example 2

(Reference Example)

Preparation of Form I of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0088] Polymorphic form I can generally be obtained by drying of the hemi-acetone solvate (Form IX) at >70 °C.

Example 3

Preparation of form III of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

a) Preparation of form III by equilibration in acetonitrile

[0089] 221.3 mg of amorphous material were digested in 500 μL of acetonitrile at ambient temperature for 2 days. The material was then isolated by filtration and dried at 22 °C/5 mbar for 48 h.

b) Characterization of form III

[0090] Form III can be characterized by XRPD patterns obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately 9.5, 10.0, 13.0, 16.7, 18.7, 20.1, 21.0, 25.6. The XRPD (X-Ray Powder Diffraction) pattern of a typical lot of form III of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide} is shown in Figure 2.

Example 4

Preparation of form IV of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0091] Form IV is a THF 0.75-solvate and can be generally obtained by processes comprising compound 1 and THF as solvent.

a) Preparation of form IV by evaporative crystallization from THF

[0092] 254.3 mg of compound 1 (form II) were dissolved in 6 mL of THF at 65 °C. After 12 h the clear solution was cooled to 5 °C. The crystals were isolated by filtration and dried at ambient conditions.

b) Characterization of form IV

[0093] Form IV can be characterized by its XRPD patterns obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately: 5.5, 7.4, 11.0, 13.4, 14.8, 16.0, 16.7, 17.1, 17.9, 19.1, 19.5, 20.1, 20.5, 20.9, 21.2, 22.2, 23.0, 23.6, 24.2, 24.5, 25.1. Figure 3 shows the XRPD pattern of a typical lot of form IV of compound 1.

Example 5

Preparation of form V of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0094] Form V is a dioxane mono-solvate and can be obtained by processes comprising compound 1 and dioxane as solvent.

a) Preparation of form V by equilibration in dioxane

[0095] 110.3 mg of amorphous material of compound 1 were suspended in 500 μL of dioxane. The wet material was digested at ambient temperature for 2 days. The material was then isolated by filtration and dried at 22 °C/5 mbar for 48 h.

b) Characterization of form V

[0096] Form V can be characterized by its XRPD pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately: 12.7, 13.1, 14.3, 16.3, 19.0, 20.1, 22.4, 25.1, 27.1, 28.9. Figure 4 shows the XRPD pattern of a typical lot of form V of compound 1.

Example 6

Preparation of form VI of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0097] Form VI is a DMF mono-solvate and can be obtained by procedures comprising compound 1 and DMF as solvent.

a) Preparation of form VI by equilibration in DMF

[0098] 120.3 mg of amorphous material were slurried in 500 μL of DMF at ambient temperature for 2 days. The brownish material was isolated by filtration and dried at 30 °C / 5 mbar 48 h.

b) Characterization of form VI

[0099] Form VI can be characterized by its XRPD pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately: 7.8, 10.3, 11.4, 11.8, 15.1, 15.6, 16.1, 16.6, 18.6, 18.9, 19.2, 20.4, 21.0, 21.6, 22.8, 24.6, 25.1, 25.8, 26.1, 27.4, 28.8. Figure 5 shows the XRPD pattern of a typical lot of form VI of compound 1.

Example 7

Preparation of form VII of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[00100] Form VII is a THF hemi-solvate and can be obtained by processes comprising compound 1 and THF as solvent.

a) Preparation of form VII by equilibration in THF

[00101] 196.3 mg of amorphous material were digested in 500 μL of THF for 3 days at ambient temperature. The brownish material was then isolated by filtration and dried at 22 ° C/5 mbar for 24 h.

b) Characterization of form VII

[00102] Form VII can be characterized by its XRPD pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately: 7.6, 9.4, 9.9, 13.1, 15.9, 16.2, 17.0, 18.1, 18.8, 19.9, 20.5, 20.7, 21.4, 21.8, 24.3, 24.9, 25.3. Figure 6 shows the XRPD pattern of a typical lot of form VII of compound 1.

Example 8

Preparation of form VIII of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

a) Preparation of form VIII by incubation of amorphous material

[00103] 210 mg of amorphous material of compound 1 were tempered at 130 °C for 24 h using a ball tube furnace. Then the brownish material was cooled to ambient temperature.

b) Characterization of form VIII

[0100] Form VIII can be characterized by its XRPD pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately: 5.0, 11.3, 11.6, 12.0, 13.8, 16.2, 16.7, 19.0, 20.1, 20.8, 22.5, 27.1. Figure 7 shows the XRPD pattern of a typical lot of form VIII of compound 1.

Example 9

Preparation of form IX of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0101] Form IX is an acetone hemi-solvate and can be obtained by processes comprising compound 1 and acetone as solvent.

a) Preparation of form IX by equilibration in acetone

[0102] 180.5 mg of amorphous material of compound 1were digested in 500 μL of acetone for 3 days at ambient temperature. Then the brownish material was isolated by filtration and dried at ambient temperature for 24 h.

b) Characterization of form IX

[0103] Form IX can be characterized by its XRPD pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately: 9.5, 9.9, 13.0, 15.9, 16.4, 17.0, 17.9, 18.7, 19.9, 20.7, 21.7, 24.8, 25.1. Figure 8 shows the XRPD pattern of a typical lot of form IX of compound 1.

Example 10

Preparation of Form X of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0104] Form X is a pyridine mono-solvate and can be generally obtained by processes comprising compound 1 and pyridine as solvent.

a) Preparation of form X by equilibration in pyridine

[0105] 150.0 mg of compound 1 (Form II) were digested in 200 μL of pyridine at ambient temperature for 10 days. Then the brownish material was isolated by filtration and dried at 22 °C at 5 mbar for 48 h.

b)Characterization of form X

[0106] Form X can be characterized by its XRPD pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately: 7.4, 9.2, 10.8, 13.6, 14.9, 19.0, 20.2, 21.4, 22.4, 23.7, 25.5, 27.0, 29. Figure 9 shows the XRPD pattern of a typical lot of form X of compound 1.

Example 11

Preparation of form XI of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0107] Form XI is a 2-methylpyridine mono-solvate and can be generally obtained by processes comprising compound 1 and 2-methylpyridine as solvent.

a) Preparation of form XI by evaporative crystallization from 2-methylpyridine

[0108] 150.0 mg of compound 1 (e.g. in its amorphous form or form II) were dissolved in 4 mL of 2-methylpyridine. The solution was allowed to evaporate passively at ambient temperature. After 10 d the material was further dried at 22 °C/5 mbar for 48 h.

b) Characterization of form XI

[0109] Form XI can be characterized by its XRPD pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately 8.0, 12.1, 12.6, 13.4, 13.9, 14.8, 16.2, 17.6, 18.5, 19.2, 20.1, 21.0, 21.4, 21.7, 23.5, 25.3, 25.5, 26.6, 27.0, 30.8. Figure 10 shows the XRPD pattern of a typical lot of form XI of compound 1.

Example 12

Preparation of form XII of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0110] Form XII is a diisopropylamine mono-solvate and can generally be obtained by processes comprising compound 1 and diisopropylamine as solvent.

a) Preparation of form XII by evaporative crystallization from 2-methylpyridine

[0111] 243.0 mg of compound 1 (form II) were slurried in 500 μL of diisopropylamine at 60 °C for 9 days. Then, the brownish material was isolated by filtration and dried at 22 °C/5 mbar for 48 h.

b) Characterization of form XII

[0112] Form XII can be characterized by an X-ray powder diffraction pattern obtained with Cu K α radiation having characteristic peaks expressed in degrees 2Theta at approximately: 7.5, 9.9, 12.1, 13.6, 16.2, 16.7, 17.1, 17.5, 18.3, 18.5, 20.1, 21.7, 22.4, 23.4, 24.3, 25.6, 26.9, 31.6. Figure 11 shows the XRPD pattern of a typical lot of form XII of compound 1.

Example 13

Preparation of form XIII of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0113] Form XIII is a morpholine mono-solvate and can generally be obtained by processes comprising compound 1 and morpholine as solvent.

a) Preparation of from XIII by incubation with morpholine vapor

[0114] 250.3 mg of amorphous material were incubated with morpholine vapor for 44 d at ambient temperature.

b) Characterization of form XIII

[0115] From XIII can be characterized by an X-ray powder diffraction pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately 5.1, 5.8, 6.9, 15.3, 16.2, 17.4, 18.4, 18.9, 19.5, 20.4, 21.1, 21.5, 22.2, 22.6, 25.2, 25.7. Figure 12 shows the XRPD pattern of a typical lot of form XIII of compound 1.

Example 14

Preparation of form XIV of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0116] Form XIV is a DMSO mono-solvate and can be generally obtained by processes comprising compound 1 and DMSO as solvent.

a) Preparation of form XIV by evaporative crystallization from DMSO

[0117] 1.2 g compound 1 (form II) were dissolved in 5 mL of DMSO at ambient temperature. The clear solution was concentrated in a vacuum tray dryer at 40 °C / 20 mbar for 2 days. The crystals were isolated by filtration and dried at ambient conditions for 4 days.

b) Characterization of form XIV

[0118] Form XIV can be characterized by an X-ray powder diffraction pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately 5.2, 10.2, 12.9, 13.9, 17.1, 17.6, 18.7, 19.8, 20.1, 20.5, 21.0, 21.7, 22.8, 24.1, 25.1, 25.5, 27.1, 27.4. Figure 13 shows the XRPD pattern of a typical lot of form XIV of compound 1.

Example 15

Preparation of form XV of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0119] Form XV is a DMSO mono-solvate and can generally be obtained by processes comprising compound 1 in DMSO as solvent.

a) Preparation of form XV by incubation with DMSO vapor

[0120] Drops of a solution of 100 mg compound 1 in 500 μL of DMSO were placed on a glass slide. After evaporation of the solvent small crystals were observed. In 3 out of 9 drops form XV was observed. The other crystallization trials yielded form XIV.

b) Characterization of form XV

[0121] Form XV can be characterized by an X-ray powder diffraction pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately 12.6, 13.8, 14.6, 16.2, 16.6, 17.8, 18.3, 20.4, 20.7, 21.4, 22.4, 23.2, 24.2, 24.5, 25.5, 26.9, 27.8, 28.7. Figure 14 shows the XRPD pattern of form XV of compound 1.

Example 16

Preparation of form XVI of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide}

[0122] Polymorphic form XVI can be obtained by heating amorphous melt films on glass slides. Form XVI could not be crystallized pure, but with form VIII.

a) Preparation of form XVI

[0123] Small amounts of compound 1(form II) were heated between a microscopic glass slide and cover glass to about 280 °C. The melt was then cooled to low temperatures by transferring the slide directly onto a cold metal block (e.g. cooled to –18 or –196 °C). The transfer should be as quick as possible. The obtained amorphous melt film is then placed on a heating stage on a microscope and observed under cross-polarized light. Upon heating with heating rates between 1 and 10 °C/min crystallization can be observed in the range from 140 - 150 °C. During this process, form VIII and form XVI crystallize side by side.

b) Characterization of form XVI

[0124] Form XVI can be characterized by a Raman spectrum as shown in Figure 15.

Example 17

Preparation of "Pattern 6"

[0125] Small amount of the amorphous material was prepared in 1 mm diameter glass capillary and heated to 150°C in a hot stage attached to a STOE Stadi P diffractometer. Subsequently the sample was analyzed at 150°C.

b) Characterization of Pattern 6

[0126] Pattern 6 can be characterized by an X-ray powder diffraction pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately 7.0, 8.4, 8.9, 13.0, 13.8, 17.7, 18.8, 20.7, 25.8, 29.7. Figure 16 shows the XRPD pattern of Pattern 6 of compound 1.

Example 18

Preparation of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide} sulfuric acid salt

[0127] The sulfuric acid salt can be obtained by processes, comprising compound 1 and sulfuric acid.

a) Preparation of the sulfuric acid salt in tetrahydrofuran

[0128] 6.15 g of compound 1 are slurried in 168.7 g of tetrahydrofuran. The suspension is heated to 55 °C. A clear solution is obtained. At 30 °C a solution of 1.4 g sulfuric acid in 5 g 2-propanol is added. At 40 °C and 20 mbar 80 mL of the solvent are removed by distillation. Subsequently 22.3 g tert.-butylmethylether are added. The solution is stirred for 12 hours at

20 °C and starts to crystallize. The solid is isolated by filtration and rinsed by 17.8 g of tetrahydrofurane.

[0129] The product is dried at 40 °C / 2 mbar for 12 h. Yield: 4.2 g (57.5%).

b) Characterization of the sulfuric acid salt

[0130] The sulfuric acid salt can be characterized by an X-ray powder diffraction pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately 4.7, 6.7, 10.6, 13.3, 14.5, 15.7, 16.4, 18.3, 18.6, 18.9, 19.5, 20.1, 20.9, 21.2, 23.2, 23.7, 24.0, 26.9, 30.0. Figure 17 shows the XRPD pattern of a typical lot of sulfuric acid salt of compound 1. The sulfuric acid salt of compound 1 can be further characterized by a melting point with onset temperature (DSC) of about 221 °C to 228 °C.

Example 19

Preparation of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide} hydrobromic acid salt (bromide salt)

[0131] The hydrobromic acid salt can be obtained by processes comprising compound 1 and hydrogen bromide.

a) Preparation of the hydrobromic acid salt in tetrahydrofuran

[0132] 6.15 g of compound 1 are slurried in 168.7 g of tetrahydrofuran. The suspension is heated to 55 °C. A clear solution is obtained. At 30 °C a solution of 3.4 g hydrobromic acid solution (33% HBr in acetic acid) is added and a white solid is precipitating. The suspension is stirred for 2 hours at 20 °C. The solid is isolated by filtration and rinsed by 17.8 g of tetrahydrofuran.

[0133] The product is dried at 40 °C / 2 mbar for 12 h. Yield: 4.6 g (61.7%).

b) Characterization of the bromide salt

[0134] The bromide salt can be characterized by an X-ray powder diffraction pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately 5.7, 6.8, 11.4, 13.6, 18.1, 19.8, 20.2, 21.4, 21.8, 24.6, 26.1, 27.3, 29.2. Figure 18 shows a XRPD pattern of a typical lot of bromide salt of compound 1.This salt can be further characterized by a melting point with onset temperature (DSC) in the range of about 240 °C to 246 °C. Melting occurs under decomposition and can vary substantially.

Example 20

Preparation of propane-1-sulfonic acid {3-[5-(4-chlorophenyl)-1H-pyrrolo [2,3-b] pyridine-3-carbonyl-2,4-difluoro-phenyl]-amide} hydrochloric acid salt

[0135] The hydrochloric acid salt can be obtained by processes comprising compound 1 and hydrogen chloride.

a) Preparation of the hydrochloric acid salt in tetrahydrofuran

[0136] 10.0 g of compound 1 are slurried in 176 g of tetrahydrofuran. The suspension is stirred at 20 °C. 4.8 g of a hydrochloric acid solution (4 M in dioxane) is added within 30 minutes. A white solid is precipitated. The suspension is stirred for additional 3 hour at 40 °C and subsequently cooled down to 20 °C. The solid is isolated by filtration and rinsed by 17.8 g of tetrahydrofuran.

[0137] The product is dried at 40 °C / 2 mbar for 12 h. Yield: 8.9 g (83.7%)

b) Characterization of the chloride salt

[0138] The chloride salt can be characterized by an X-ray powder diffraction pattern obtained with Cu Kα radiation having characteristic peaks expressed in degrees 2Theta at approximately 6.6, 7.8, 11.2, 12.6, 14.1, 14.7, 16.3, 17.8, 19.3, 19.6, 20.7, 21.5, 22.7, 24.1, 25.4, 25.8. Figure 19 shows the XRPD pattern of a typical lot of hydrochloric acid salt of compound 1.

Example 21

Spray dry dispersion solution preparation

[0139] Compound (1) was dispersed in acetone or a mix of THF/acetone, an excess of 1 mol equivalent of 2M hydrochloric acid was dispensed into the vessel and stirred until dissolved. Isopropanol was dispensed into the vessel and allowed to stir. Excess hydrochloric acid was sufficient in maintaining solution stability for spray drying.

[0140] Polymer solutions of hydroxypropyl methyl cellulose acetate succinate (HPMCAS), copolymers of methacrylic acid and ethylacrylate (L100-55) or copolymer of vinylpyrrolidone-vinyl acetate (PVPVA) were prepared respectively by dissolving polymers into ethanol, adding an appropriate amount of acetone to the dissolved polymer solution, dispensing compound (1) into the polymer solution, and heating the solution to approximately 45 °C until all components were fully dissolved. The solutions were cooled back to room temperature prior to spray drying.

Example 22

Spray dry dispersion solution preparation and manufacturing

[0141] Each formula was spray dried using a target inlet temperature of 100-105 °C, an outlet temperature of 55 °C, and an atomizing gas pressure of 0.5 bar. The feed material was atomized using a 0.5 mm two-fluid Schlick nozzle for all runs. Collection of the product is at the cyclone. A variable speed peristaltic pump, Master Flex, equipped with #14 Tygon Chemical tubing, was used to deliver the feed material.

[0142] Spray dried dispersions were vacuum oven dried overnight for 65 hours at 37 °C under a reduced pressure between -25 to -30 in Hg (Stage 1). These samples were further vacuum oven dried for an additional 65 hours at 45 °C under a reduced pressure between -25 to -30 in Hg (Stage 2). Spray dried dispersions were vacuum oven dried for 65 hours at 45 °C under a reduced pressure between -25 to -30 in Hg. Residual solvent are below 5000 PPM.

[0143] Spray dry dispersion solutions for amorphous forms XVII, XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV or XXVI were prepared according to the procedure set forth in Example 21. Spray dry dispersion formulas of amorphous forms XVII, XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV or XXVI were prepared according to the procedure set forth in Example 22.

[0144] Table 1 illustrates the spray dry dispersion of formulations of amorphous forms XVII, XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV and XXVI.

Table 1

Compound No.	Polymer	Formulation	Solvent
XVII	HPMCAS	Compound (1)-30% HPMCAS – 70%	THF: Acetone – 20%:80%
XVIII		Compound (1)-30% HPMCAS – 70%	THF: Acetone – 20%:80%
XIX		Compound (1)-30% HPMCAS – 70%	THF: Acetone – 20%:80%
XX		Compound (1)-30% HPMCAS – 70% HCl salt	Acetone 100%
XXI		Compound (1)-50% HPMCAS – 50% HCl salt	Acetone 100%
XXII		Compound (1)-33% HPMCAS – 67% HCl Salt	Acetone: IPA: water – 95%:3.8%: 1.2%
XXIII		Compound (1)-40% HPMCAS – 60% HCl Salt	Acetone: IPA: water – 95%:3.8%: 1.2%
XXIV	L100-55	Compound (1)-50% L100-55 – 50% HCl salt	THF: Acetone – 20%:80%
XXV	PVPVA	Compound (1)-33.3% PVPVA – 33.3% PVPK30 – 33.3%	Acetone: Ethanol – 20%:80%
XXVI	PVPVA	Compound (1)-33% PVPVA – 67%	Acetone: Ethanol – 20%:80%

Example 23

Characterization of the compounds

a) Characterization of solid form XVII

[0145] Solid form XVII was characterized by X-ray powder diffraction analysis obtained with Cu Kα radiation. The X-ray powder diffraction pattern consists of a broad halo peak with minor sharp peaks expressed in degrees 2Theta. The locations of the minor sharp peaks are shown in the table below. Figure 20 shows a XRPD pattern of a typical lot of a substantially amorphous solid state form XVII.

Angle 2-Theta °	d value Angstrom	Intensity Count	Intensity % %
3.276	26.94524	8.42	1.2
4.747	18.59877	32.6	4.8
5.683	15.53955	5.75	0.8
7.591	11.6373	57.9	8.5
8.44	10.46849	48.7	7.2
9.224	9.57963	169	24.9
9.505	9.29756	403	59.3
9.882	8.9438	421	62
11.651	7.58897	72.9	10.7
11.93	7.41246	21.5	3.2
12.645	6.99485	89.4	13.1
13.015	6.79687	277	40.8
13.528	6.54031	47.5	7
14.037	6.30422	53.9	7.9
14.451	6.12451	57.5	8.5
14.986	5.90686	88.8	13.1
15.226	5.81445	105	15.5
15.6	5.67585	59.8	8.8
15.929	5.55933	159	23.3
16.281	5.43993	167	24.6
16.922	5.23544	205	30.1
17.36	5.10417	13.9	2
17.842	4.9673	204	29.9
18.377	4.8238	108	15.8
18.635	4.75784	307	45.2
19.074	4.64921	216	31.8
19.83	4.47353	211	31.1
20.596	4.30896	269	39.6
21.4	4.14883	272	40
21.627	4.10574	379	55.7
22.521	3.94481	93.2	13.7
23.038	3.85742	56.8	8.4
23.44	3.79217	35.1	5.2
24.06	3.69583	200	29.4
24.347	3.65298	417	61.3
24.959	3.56467	680	100
25.713	3.46183	277	40.7
26.099	3.4115	162	23.8
26.515	3.35901	90.4	13.3
27.052	3.29348	55.7	8.2
27.753	3.21192	111	16.3
28.041	3.17956	110	16.1
28.742	3.10358	88.4	13
29.18	3.05796	74.8	11
30.077	2.96872	113	16.6
30.5	2.92855	61	9
31.089	2.87436	48.2	7.1
31.572	2.8315	106	15.6
32.076	2.78817	97.1	14.3
32.387	2.76212	85	12.5
32.84	2.72502	44.8	6.6
32.963	2.71514	65.4	9.6
33.065	2.70701	61	9
33.201	2.69622	63.5	9.3
33.64	2.66201	17.7	2.6
33.924	2.6404	28	4.1
34.462	2.6004	64.3	9.5
35.359	2.53645	44	6.5
35.378	2.53515	44	6.5
35.712	2.51218	72.6	10.7
35.952	2.49597	83.8	12.3
36.736	2.44447	42.5	6.3
37.149	2.41824	63	9.3
37.764	2.38023	55.7	8.2
37.873	2.37368	50.7	7.5
38.322	2.3469	17.3	2.5
38.6	2.33061	32.6	4.8
38.79	2.31961	70.8	10.4
39.147	2.29927	45.2	6.6
39.397	2.2853	70.5	10.4
40.035	2.25029	47.3	7
40.277	2.23737	36.6	5.4
41.1	2.19443	42.6	6.3
41.218	2.18844	37.8	5.6
41.62	2.16821	40.3	5.9
42.496	2.12551	77.5	11.4
42.972	2.10308	52.1	7.7
43.1	2.09714	72.3	10.6
43.72	2.06881	65.1	9.6
44.24	2.04569	32.9	4.8
44.535	2.03284	36.3	5.3

b) Characterization of solid form XVIII

[0146] Solid form XVIII was characterized by X-ray powder diffraction analysis obtained with Cu Kα radiation. The X-ray powder diffraction pattern exhibits two broad halo peaks expressed in degrees 2Theta as shown in Figure 21.

c) Characterization of solid form XIX

[0147] Solid form XIX was characterized by X-ray powder diffraction analysis obtained with Cu Kα radiation. The X-ray powder diffraction pattern consists of a broad halo peak with minor sharp peaks expressed in degrees 2Theta. Figure 22 shows a XRPD pattern of a typical lot of a substantially amorphous solid state form XIX.

d) Characterization of solid form XX

[0148] Solid form XX was characterized by X-ray powder diffraction analysis obtained with Cu Kα radiation. The X-ray powder diffraction pattern consists of a broad halo peak with minor sharp peaks expressed in degrees 2Theta. Figure 23 shows a XRPD pattern of a typical lot of a substantially amorphous solid state form XX.

e) Characterization of solid form XXI

[0149] Solid form XXI was characterized by X-ray powder diffraction analysis obtained with Cu Kα radiation. The X-ray powder diffraction pattern consists of a broad halo peak with minor sharp peaks expressed in degrees 2Theta. Figure 24 shows a XRPD pattern of a typical lot of a substantially amorphous solid state form XXI.

f) Characterization of solid form XXII

[0150] Solid form XXII was characterized by X-ray powder diffraction analysis obtained with Cu Kα radiation. The X-ray powder diffraction pattern consists of a broad halo peak expressed in degrees 2Theta. Figure 25 shows a XRPD pattern of a typical lot of a substantially amorphous solid state form XXII.

g) Characterization of solid form XXIII

[0151] Solid form XXIII was characterized by X-ray powder diffraction analysis obtained with Cu Kα radiation. The X-ray powder diffraction pattern consists of a broad halo peak expressed in degrees 2Theta. Figure 26 shows a XRPD pattern of a typical lot of a substantially amorphous solid state form XXIII.

h) Characterization of solid form XXIV

[0152] Solid form XXIV was characterized by X-ray powder diffraction analysis obtained with Cu Kα radiation. The X-ray powder diffraction pattern consists of a broad halo peak with minor sharp peaks expressed in degrees 2Theta. Figure 27 shows a XRPD pattern of a typical lot of a substantially amorphous solid state form XXIV.

i) Characterization of solid form XXV

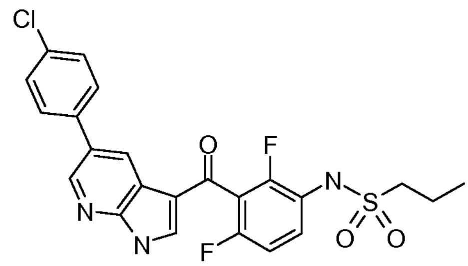
[0153] Solid form XXV was characterized by X-ray powder diffraction analysis obtained with Cu Kα radiation. The X-ray powder diffraction pattern consists of a broad halo peak expressed in degrees 2Theta. Figure 28 shows a XRPD pattern of a typical lot of a substantially amorphous solid state form XXV.

j) Characterization of solid form XXVI

[0154] Solid form XXVI was characterized by X-ray powder diffraction analysis obtained with Cu Kα radiation. The X-ray powder diffraction pattern consists of a broad halo peak expressed in degrees 2Theta. Figure 29 shows a XRPD pattern of a typical lot of a substantially amorphous solid state form XXVI..

Claims

1. A solid form of the compound of formula 1,



(1),

wherein said solid form is selected from the group consisting of

a) a substantially amorphous form of compound 1 selected from form XVII, XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV, XXVI or combinations thereof, wherein the compound 1 is molecularly dispersed;

b) a solvate of form III, IV, V, VI, VII, IX, X, XI, XII, XIII, XIV or XV;

c) a polymorph of form VIII or XVI; and

d) the sulfuric acid-, hydrobromic acid- or hydrochloric acid salt of compound 1.

2. The solid form of claim 1, selected from a substantially amorphous form of compound 1 selected from form XVII, XVIII, XIX, XX, XXI, XXII, XXIII, XXIV, XXV, XXVI or combinations thereof, wherein compound 1 is molecularly dispersed within a polymer matrix.

3. The solid form (XVII) of claim 2, characterized by an X-ray powder diffraction pattern substantially as shown in Fig. 20.

4. The solid form (XVIII) of claim 2, characterized by an X-ray powder diffraction pattern substantially as shown in Fig. 21.

5. The solid form (XIX) of claim 2, characterized by an X-ray powder diffraction pattern substantially as shown in Fig. 22.

6. The solid form (XX) of claim 2, characterized by an X-ray powder diffraction pattern substantially as shown in Fig. 23.

7. The solid form (XXI) of claim 2, characterized by an X-ray powder diffraction pattern substantially as shown in Fig. 24.

8. The solid form (XXII) of claim 2, characterized by an X-ray powder diffraction pattern substantially as shown in Fig. 25.

9. The solid form (XXIII) of claim 2, characterized by an X-ray powder diffraction pattern substantially as shown in Fig. 26.

10. The solid form (XXIV) of claim 2, characterized by an X-ray powder diffraction pattern substantially as shown in Fig. 27.

11. The solid form (XXV) of claim 2, characterized by an X-ray powder diffraction pattern substantially as shown in Fig. 28.

12. The solid form (XXVI) of claim 2, characterized by an X-ray powder diffraction pattern substantially as shown in Fig. 29.

13. The solid form of any of claims 2-12, wherein the solid form is prepared by a spray dispersion process.

14. The solid form of any of claims 2-13, wherein the polymer is selected from hydroxypropyl methyl cellulose acetate succinate (HPMCAS), hydroxypropylmethyl cellulose, methacrylic acid copolymers, polyvinylpyrrolidone (povidone), 4-vinylpyrrolidone-vinyl acetate copolymer (copovidone) or copolymers of methacrylic acid and ethylacrylate (EUDRAGIT® L100-55).

15. A pharmaceutical composition comprising at least one solid form according to any of claims 2-14, or a pharmaceutically acceptable salt thereof, and a pharmaceutically acceptable carrier, additives or excipients.

16. A method for treating a disease or condition in a mammal in need thereof, said method comprising: administering to said mammal an effective amount of a composition of claim 15.

17. The method of claim 16, wherein the disease or condition is melanoma, thyroid cancer or colon cancer.

18. The solid form of claim 1, selected from a solvate of form III, IV, V, VI, VII, IX, X, XI, XII, XIII, XIV or XV.

19. The solid form of claim 1, selected from a polymorph of form VIII or XVI.

20. The solid form of claim 1, selected from the sulfuric acid-, hydrobromic acid- or hydrochloric acid salt of compound 1.

21. A solid form (form III) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 9.5, 10.0, 13.0, 16.7, 18.7, 20.1, 21.0 and 25.6 degrees 2Theta (± 0.2 degrees 2Theta).

22. A solid form (form IV) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 5.5, 7.4, 11.0, 13.4, 14.8, 16.0, 16.7, 17.1, 17.9, 19.1, 19.5, 20.1, 20.5, 20.9, 21.2, 22.2, 23.0, 23.6, 24.2, 24.5 and 25.1 degrees 2Theta (± 0.2 degrees 2Theta).

23. A solid form (form V) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 12.7, 13.1, 14.3, 16.3, 19.0, 20.1, 22.4, 25.1, 27.1 and 28.9 degrees 2Theta (± 0.2 degrees 2Theta).

24. A solid form (form VI) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 7.8, 10.3, 11.4, 11.8, 15.1, 15.6, 16.1, 16.6, 18.6, 18.9, 19.2, 20.4, 21.0, 21.6, 22.8, 24.6, 25.1, 25.8, 26.1, 27.4 and 28.8 degrees 2Theta (± 0.2 degrees 2Theta).

25. A solid form (form VII) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 7.6, 9.4, 9.9, 13.1, 15.9, 16.2, 17.0, 18.1, 18.8, 19.9, 20.5, 20.7, 21.4, 21.8, 24.3, 24.9 and 25.3 degrees 2Theta (± 0.2 degrees 2Theta).

26. A solid form (form IX) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 9.5, 9.9, 13.0, 15.9, 16.4, 17.0, 17.9, 18.7, 19.9, 20.7, 21.7, 24.8 and 25.1 degrees 2Theta (± 0.2 degrees 2Theta).

27. A solid form (form X) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 7.4, 9.2, 10.8, 13.6, 14.9, 19.0, 20.2, 21.4, 22.4, 23.7, 25.5, 27.0 and 29.8 degrees 2Theta (± 0.2 degrees 2Theta).

28. A solid form (form XI) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 8.0, 12.1, 12.6, 13.4, 13.9, 14.8, 16.2, 17.6, 18.5, 19.2, 20.1, 21.0, 21.4, 21.7, 23.5, 25.3, 25.5, 26.6, 27.0 and 30.8 degrees 2Theta (± 0.2 degrees 2Theta).

29. A solid form (form XII) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 7.5, 9.9, 12.1, 13.6, 16.2, 16.7, 17.1, 17.5, 18.3, 18.5, 20.1, 21.7, 22.4, 23.4, 24.3, 25.6, 26.9 and 31.6 degrees 2Theta (± 0.2 degrees 2Theta).

30. A solid form (form XIII) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 5.1, 5.8, 6.9, 15.3, 16.2, 17.4, 18.4, 18.9, 19.5, 20.4, 21.1, 21.5, 22.2, 22.6, 25.2 and 25.7 degrees 2Theta (± 0.2 degrees 2Theta).

31. A solid form (form XIV) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 5.2, 10.2, 12.9, 13.9, 17.1, 17.6, 18.7, 19.8, 20.1, 20.5, 21.0, 21.7, 22.8, 24.1, 25.1, 25.5, 27.1 and 27.4 degrees 2Theta (± 0.2 degrees 2Theta).

32. A solid form (form XV) according to claim 18, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 12.6, 13.8, 14.6, 16.2, 16.6, 17.8, 18.3, 20.4, 20.7, 21.4, 22.4, 23.2, 24.2, 24.5, 25.5, 26.9, 27.8 and 28.7 degrees 2Theta (± 0.2 degrees 2Theta).

33. A solid form designated “pattern 6” according to claim 18, characterized in that it comprises signals in its X-ray powder diffraction curve at positions 7.0, 8.4, 8.9, 13.0, 13.8, 17.7, 18.8, 20.7, 25.8 and 29.7 degrees 2Theta (± 0.2 degrees 2Theta).

34. A solid form (form VIII) according to claim 19, characterized in that it comprises signals in its X-ray powder diffraction curve at positions 5.0, 11.3, 11.6, 12.0, 13.8, 16.2, 16.7, 19.0, 20.1, 20.8, 22.5 and 27.1 degrees 2Theta (± 0.2 degrees 2Theta).

35. A solid form (form XVI) according to claim 19, characterized by its Raman spectrum as presented in Figure 15.

36. The sulfuric acid salt according to claim 20, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 4.7, 6.7, 10.6, 13.3, 14.5, 15.7, 16.4, 18.3, 18.6, 18.9, 19.5, 20.1, 20.9, 21.2, 23.2, 23.7, 24.0, 26.9 and 30.0 degrees 2Theta (± 0.2 degrees 2Theta).

37. The hydrobromic acid salt according to claim 20, characterized by an X-ray powder diffraction pattern comprising characteristic peas at approximately 5.7, 6.8, 11.4, 13.6, 18.1, 19.8, 20.2, 21.4, 21.8, 24.6, 26.1, 27.3 and 29.2 degrees 2Theta (± 0.2 degrees 2Theta).

38. The hydrochloric acid salt according to claim 20, characterized by an X-ray powder diffraction pattern comprising characteristic peaks at approximately 6.6, 7.8, 11.2, 12.6, 14.1, 14.7, 16.3, 17.8, 19.3, 19.6, 20.7, 21.5, 22.7, 24.1, 25.4 and 25.8 degrees 2Theta (± 0.2 degrees 2Theta).

39. A pharmaceutical composition comprising at least one of the solid forms according to any one of claims 18 to 38, together with pharmaceutically acceptable additives, carriers or excipients.

40. The solid forms, methods of making them, compositions containing them and uses as described herein before.

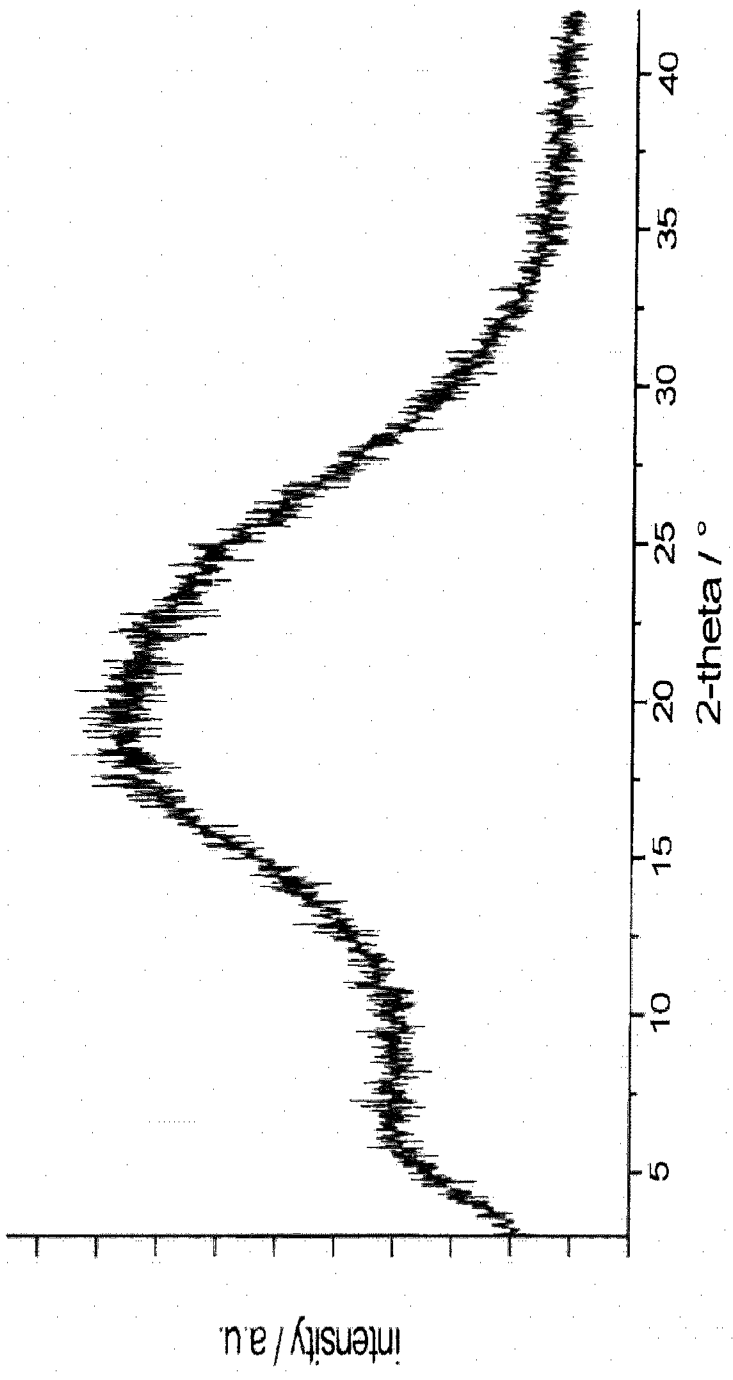


Fig. 1

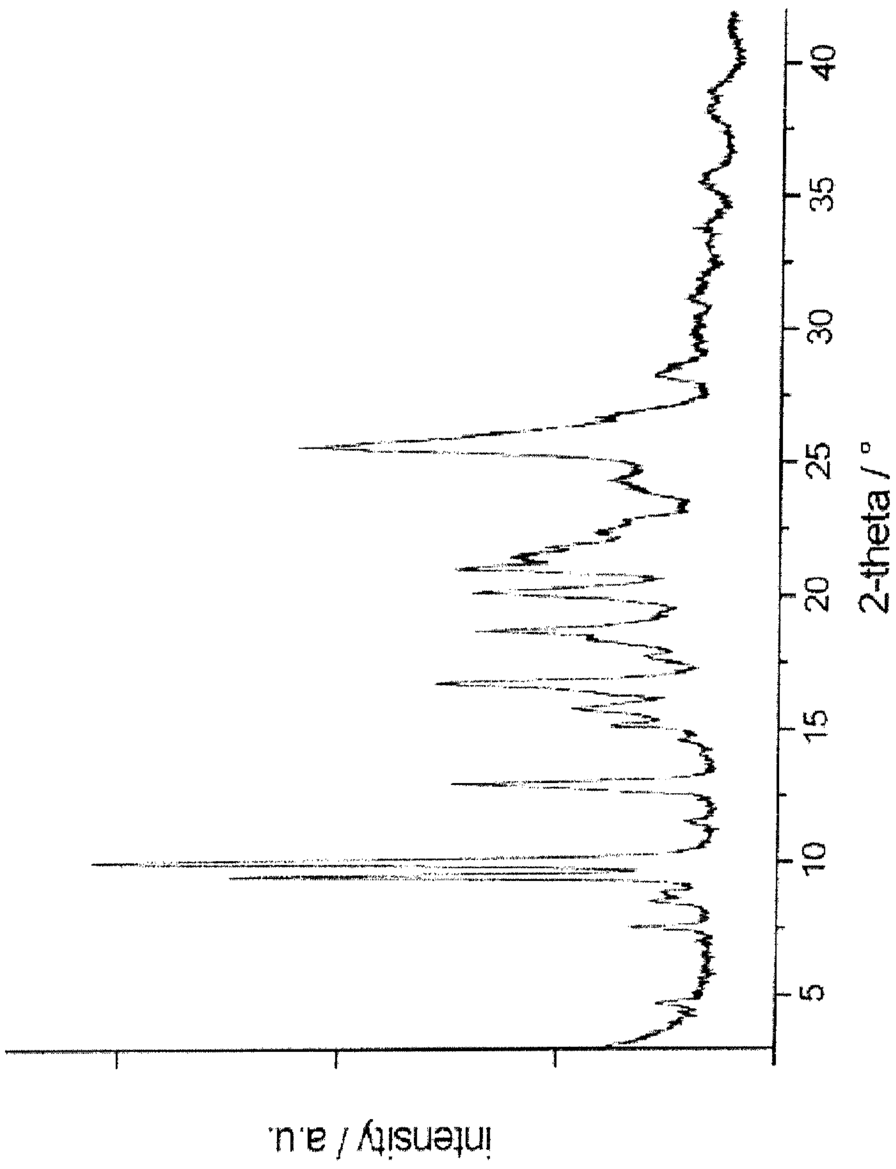
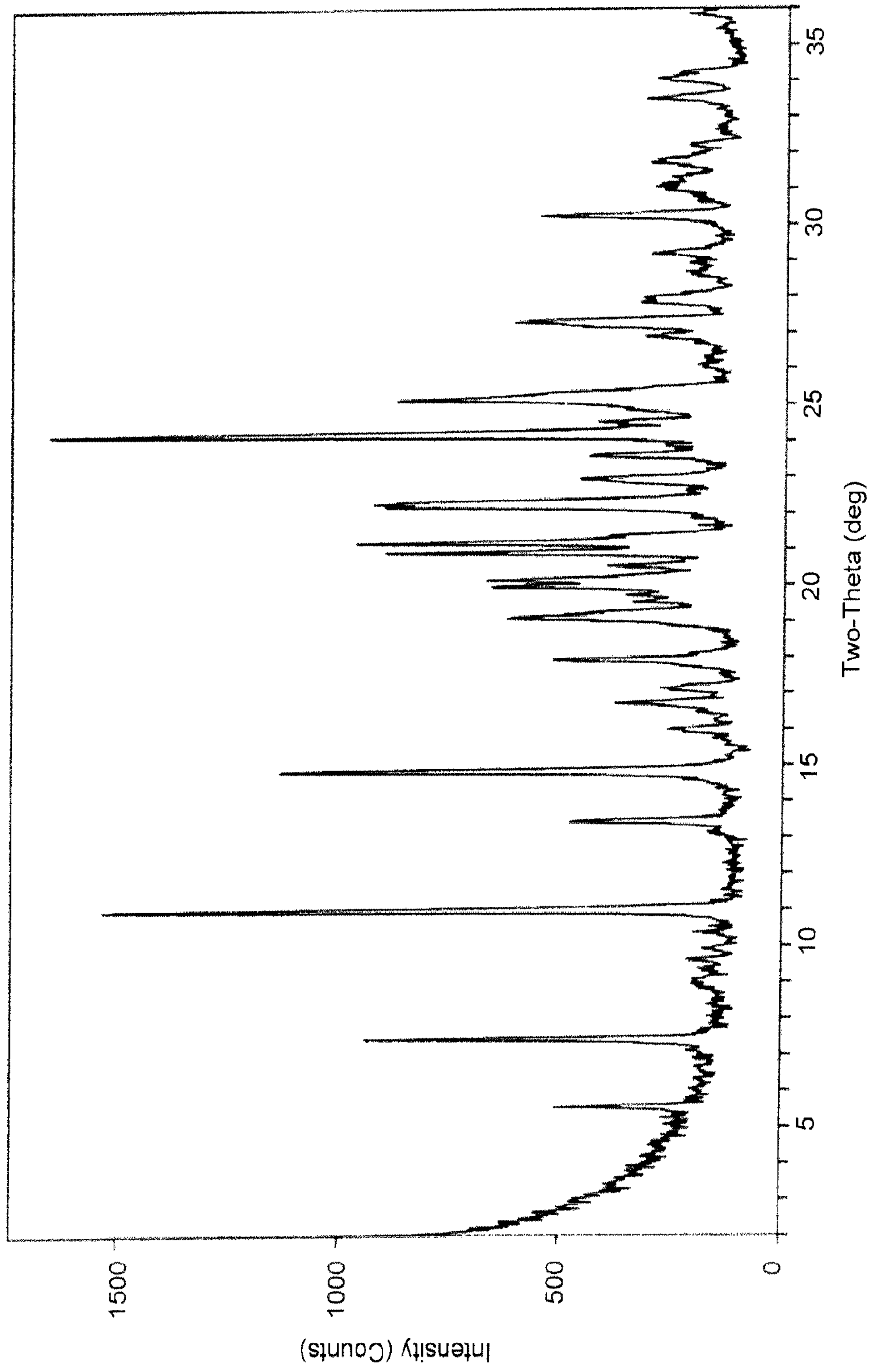


Fig. 2



Intensity (Counts)
1500
1000
500
0
Two-Theta (deg)
5
10
15
20
25
30
35

Fig. 3

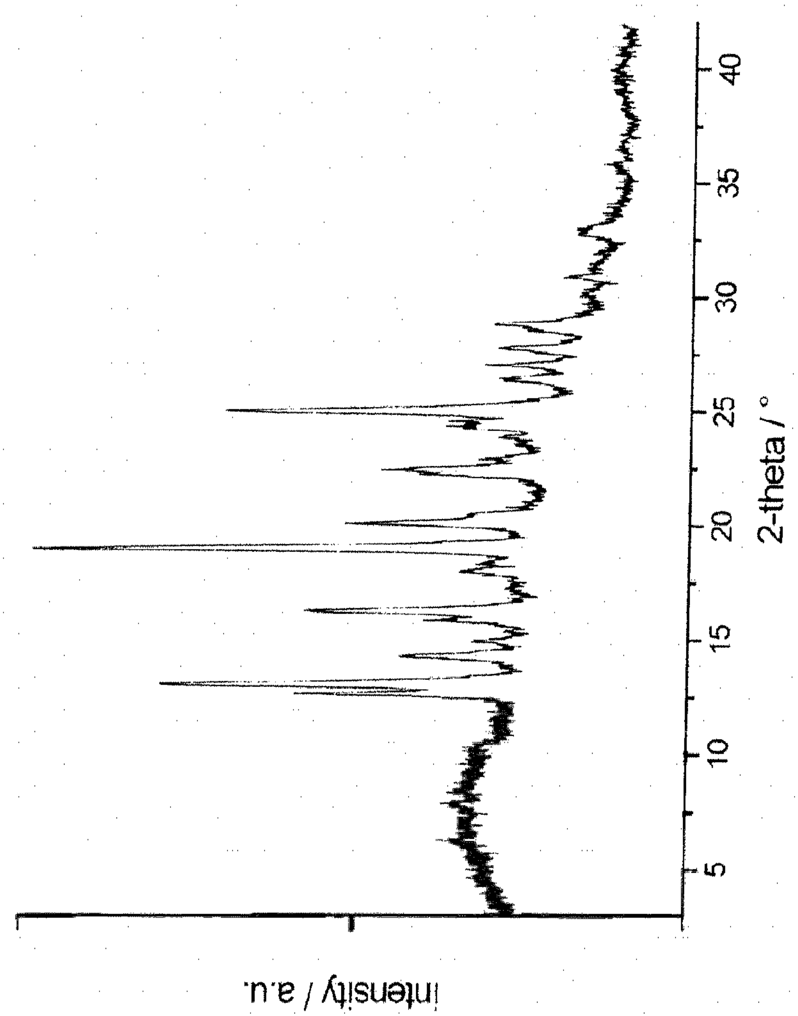


Fig. 4

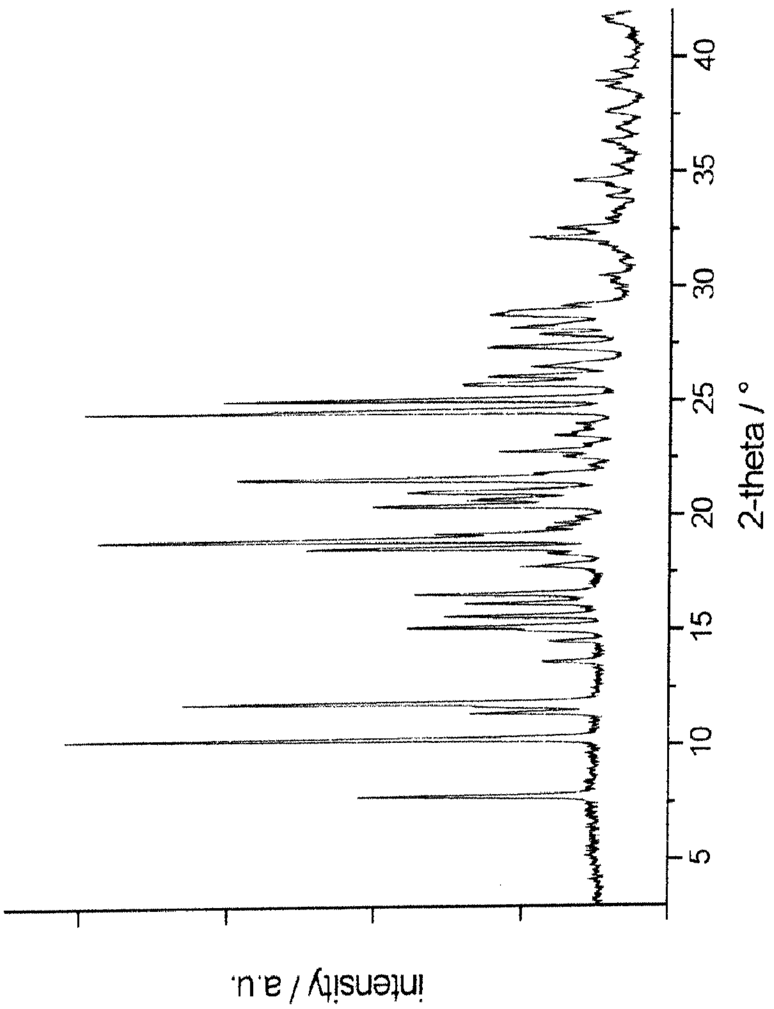


Fig.5

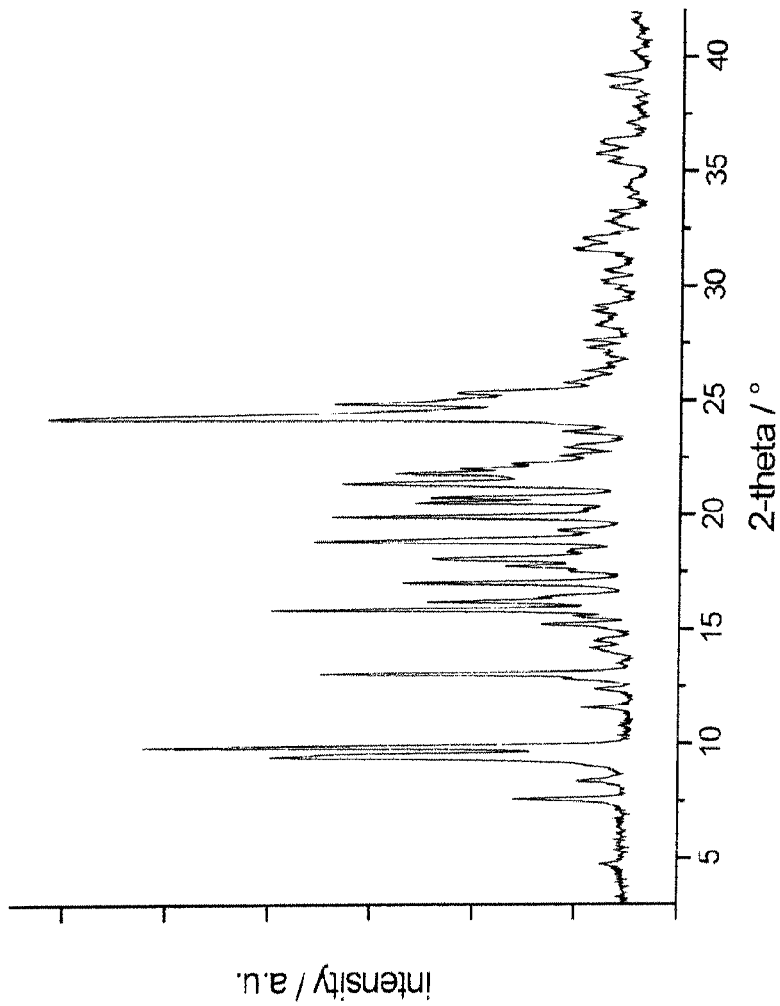


Fig. 6

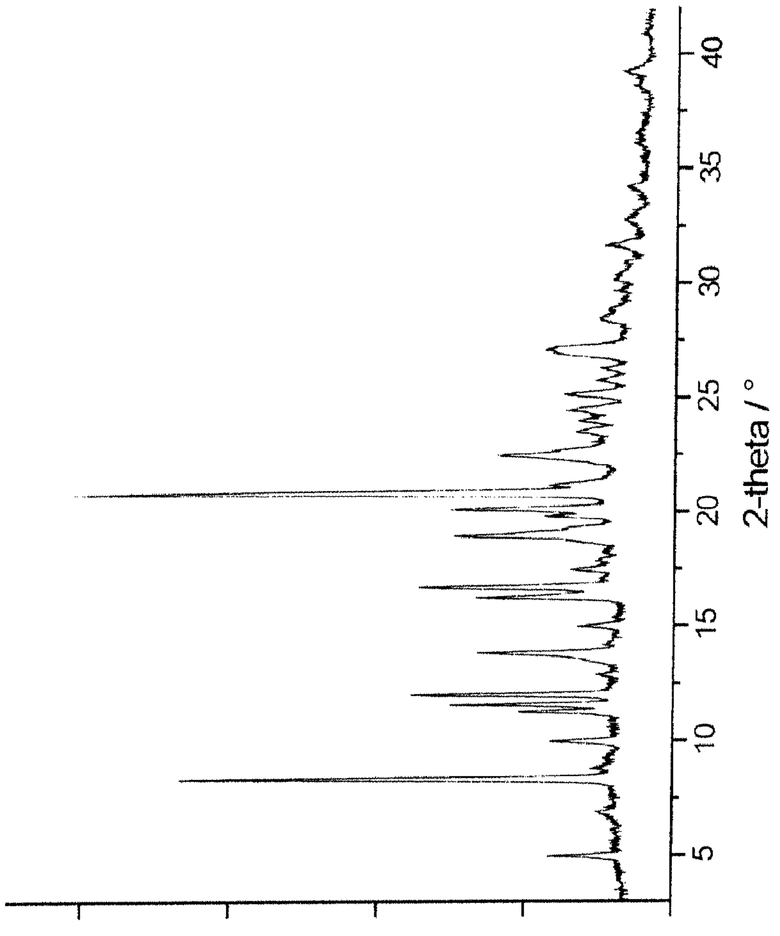


Fig. 7

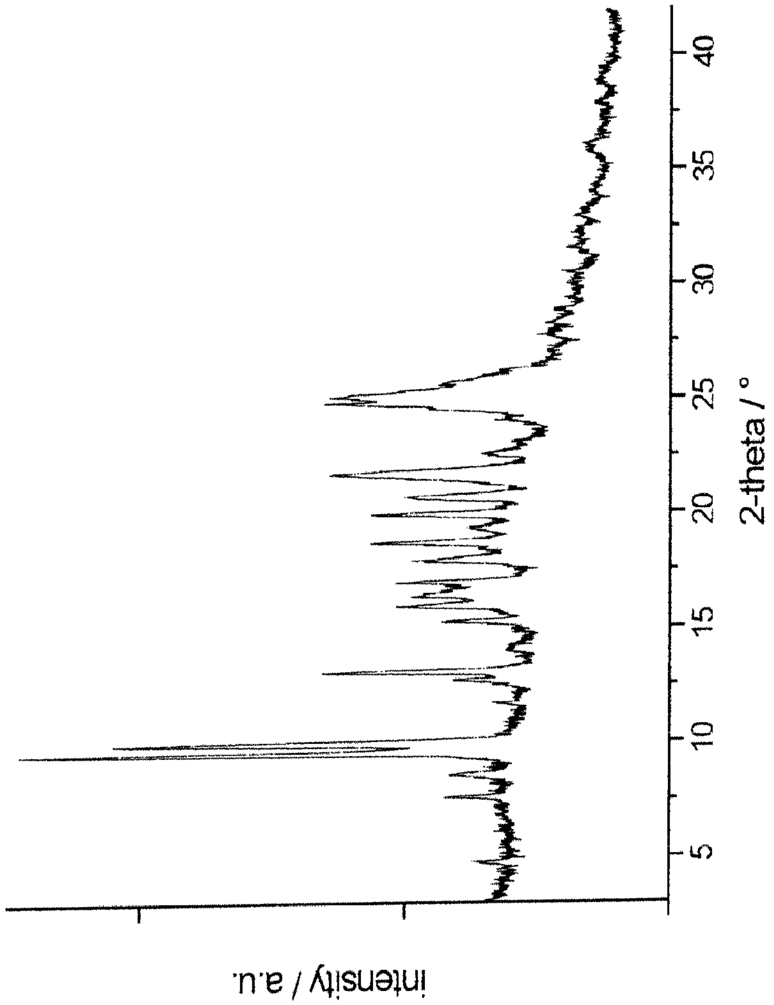


Fig. 8

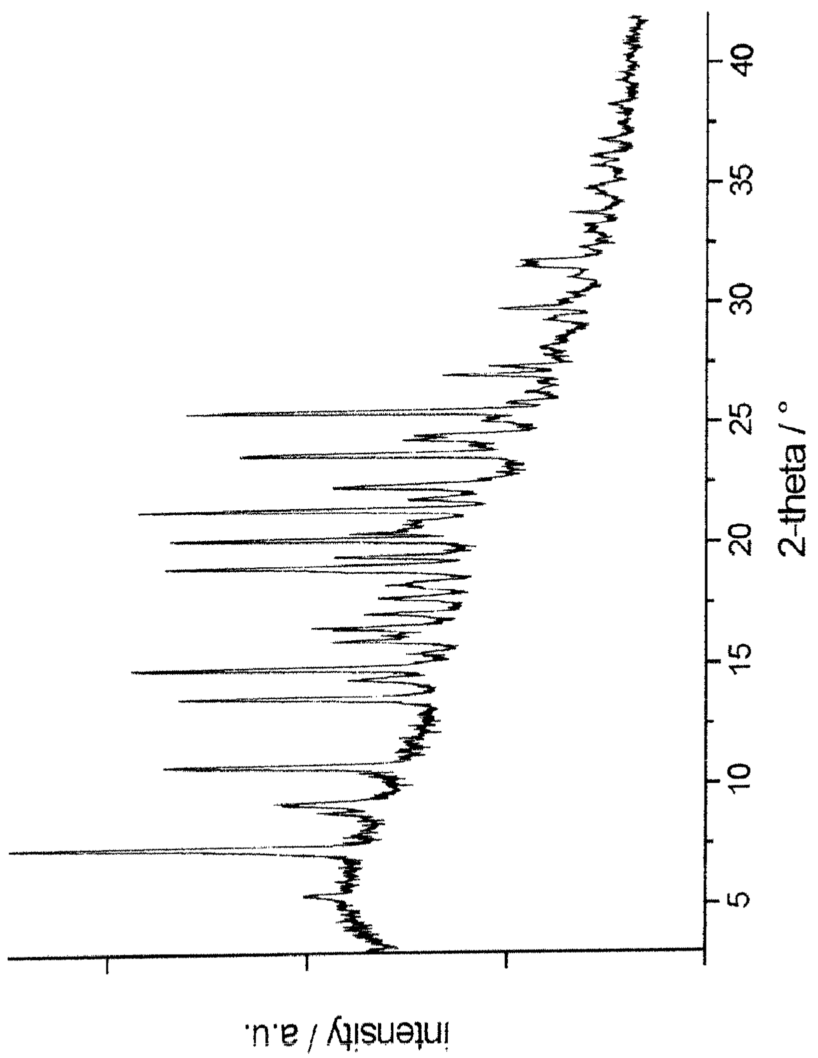


Fig. 9

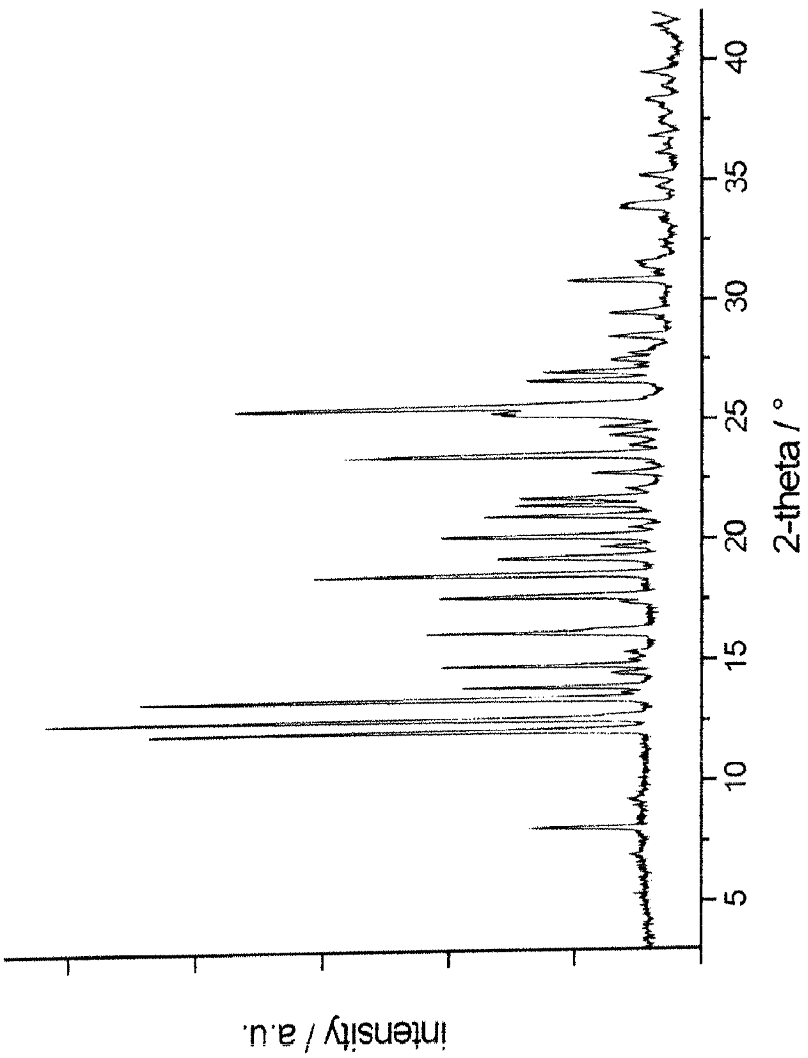


Fig. 10

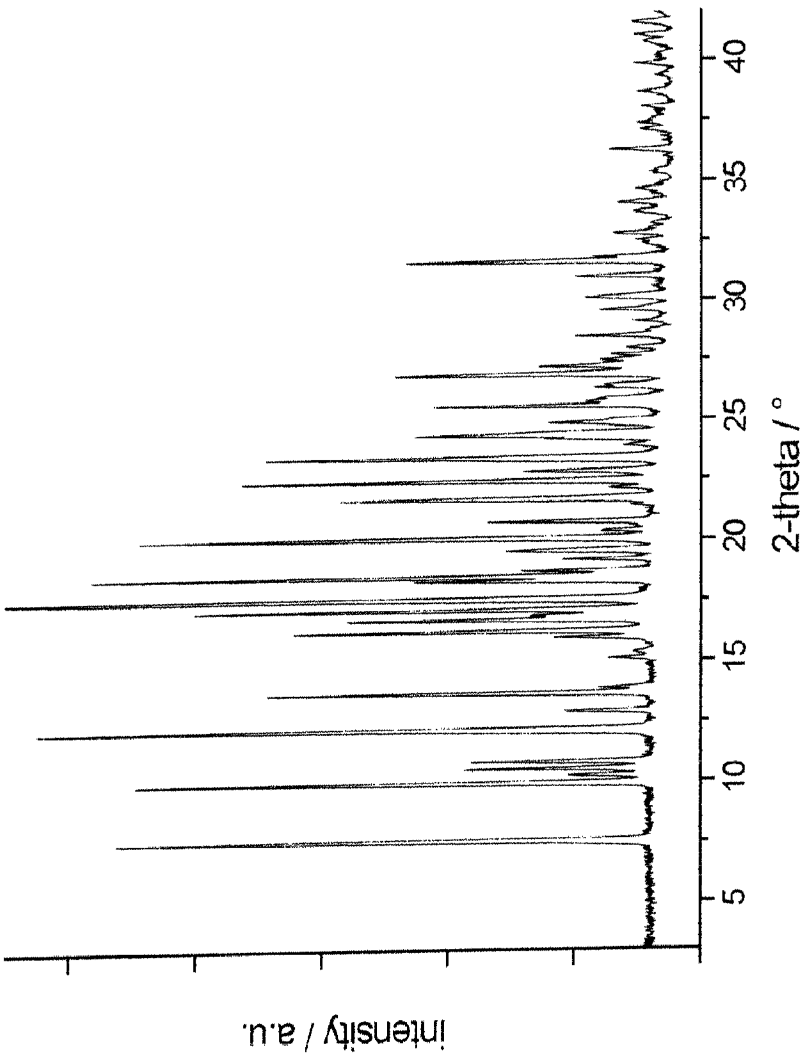


Fig. 11

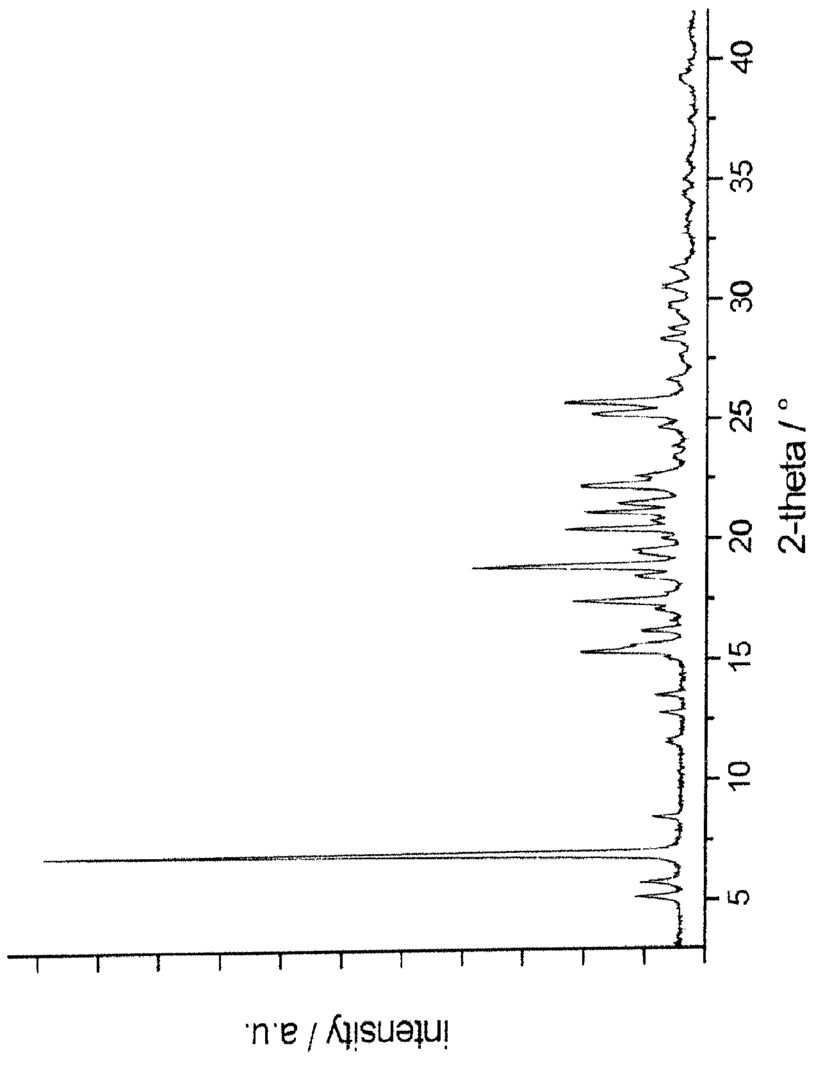


Fig. 12

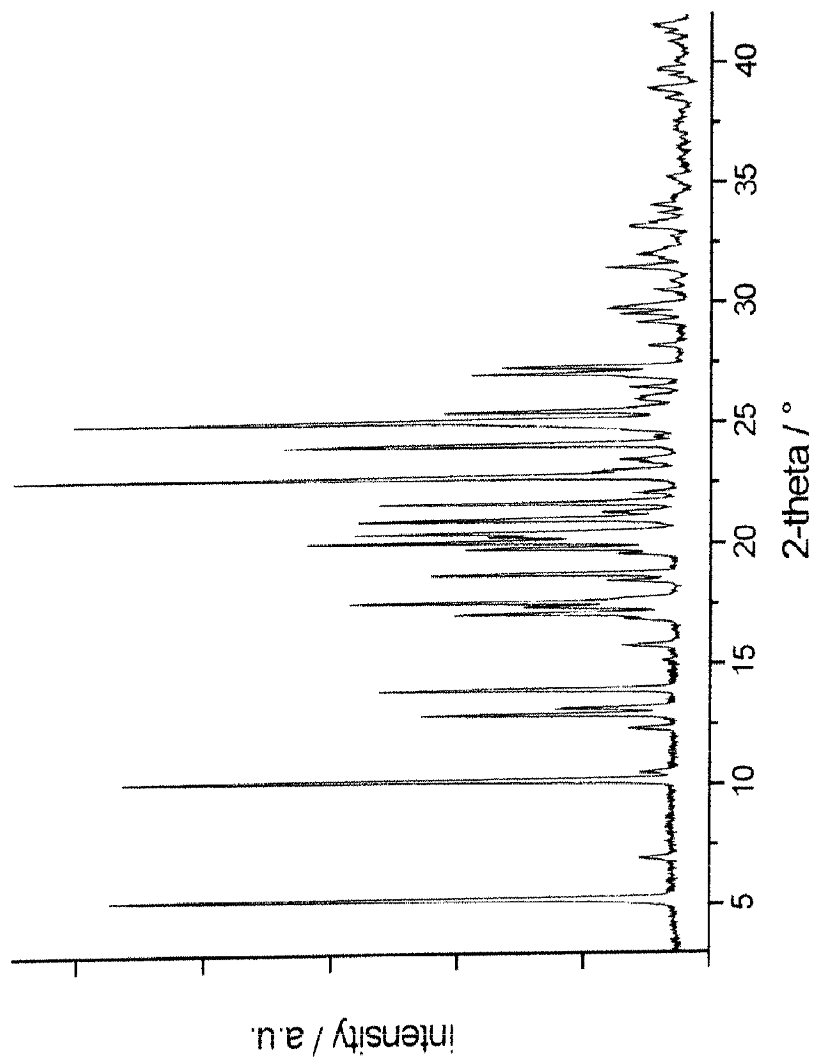


Fig. 13

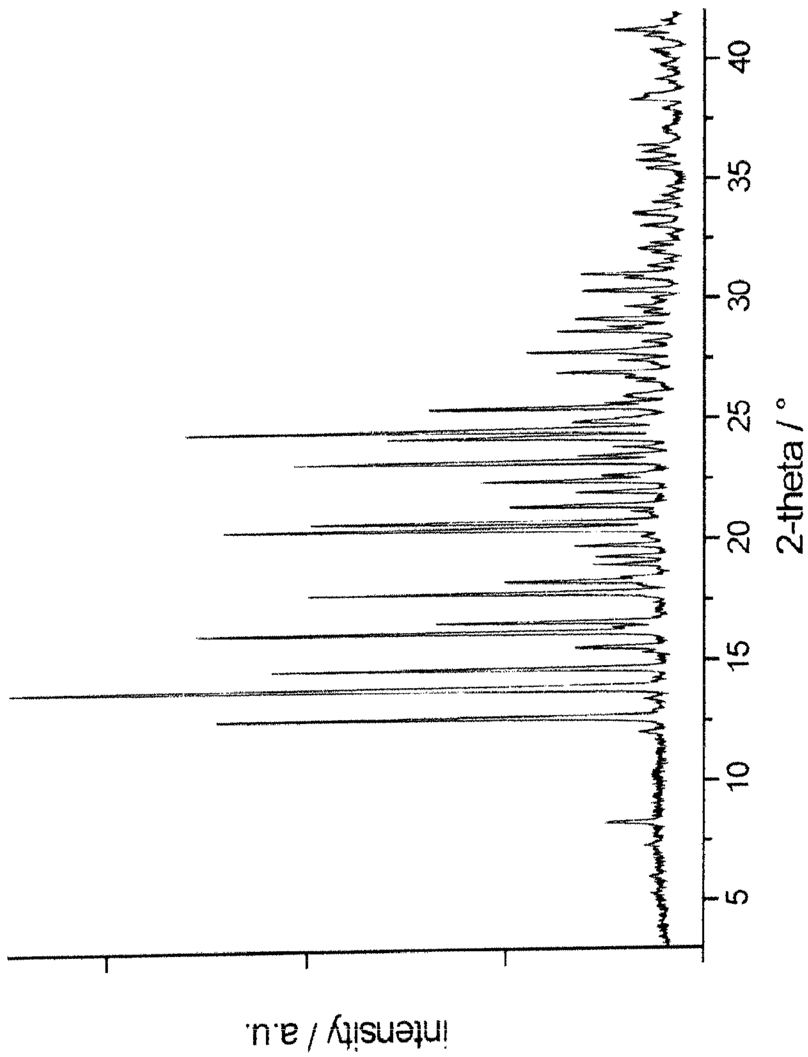


Fig. 14

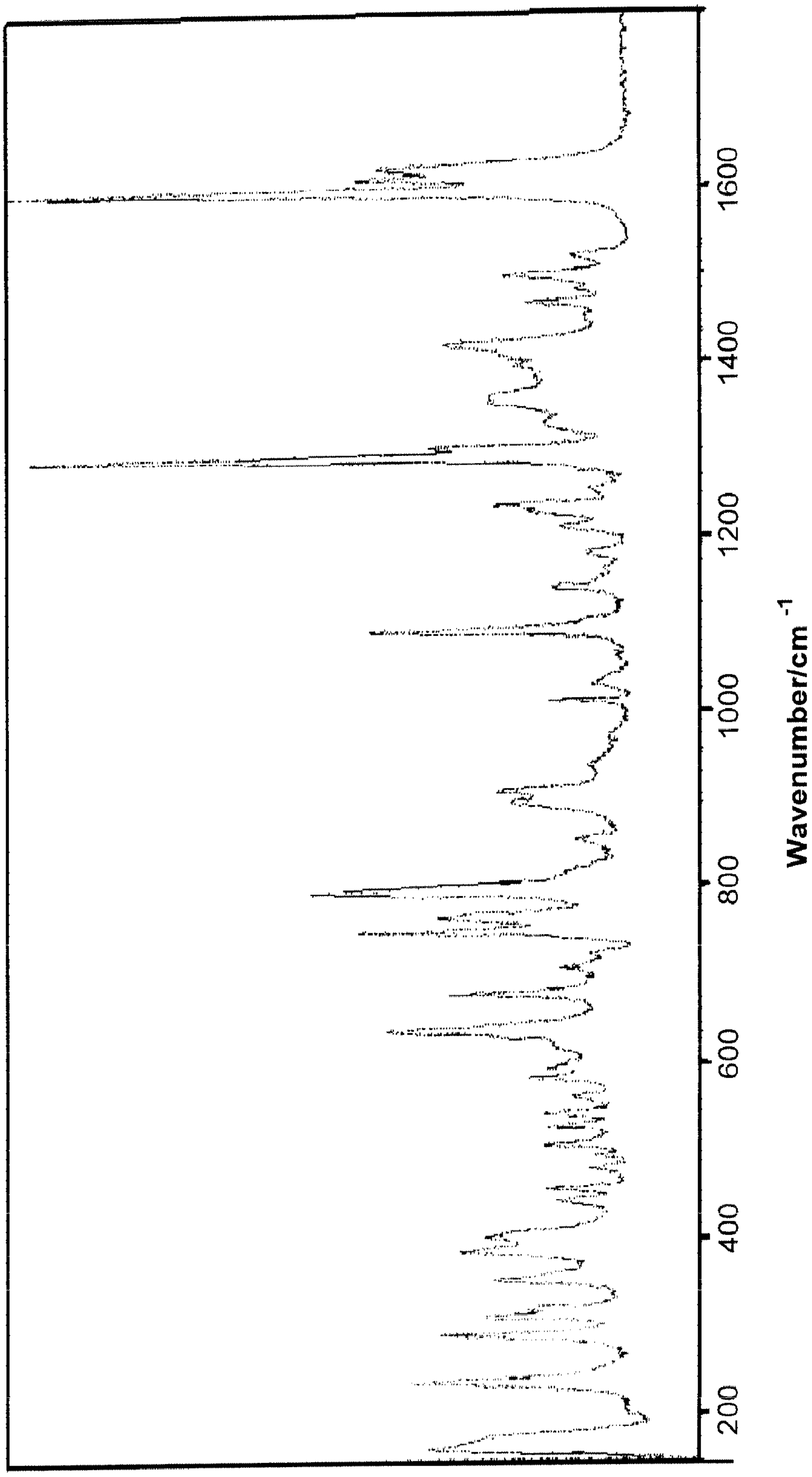


Fig. 15

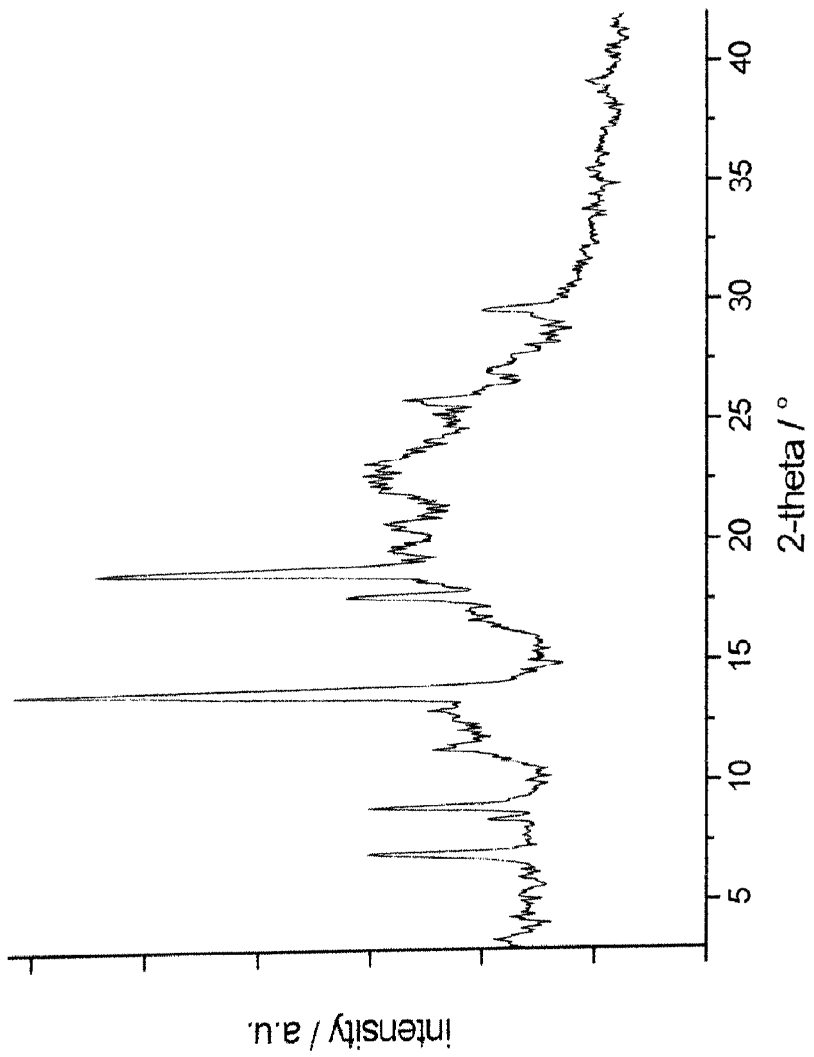


Fig. 16

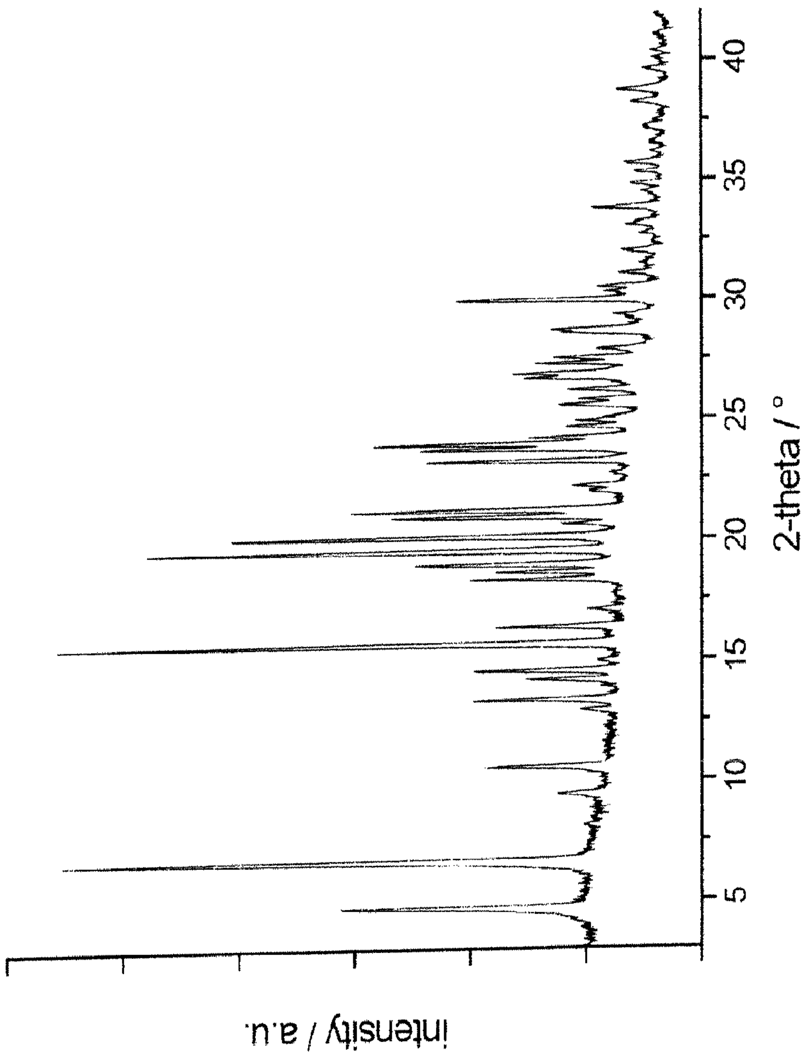


Fig. 17

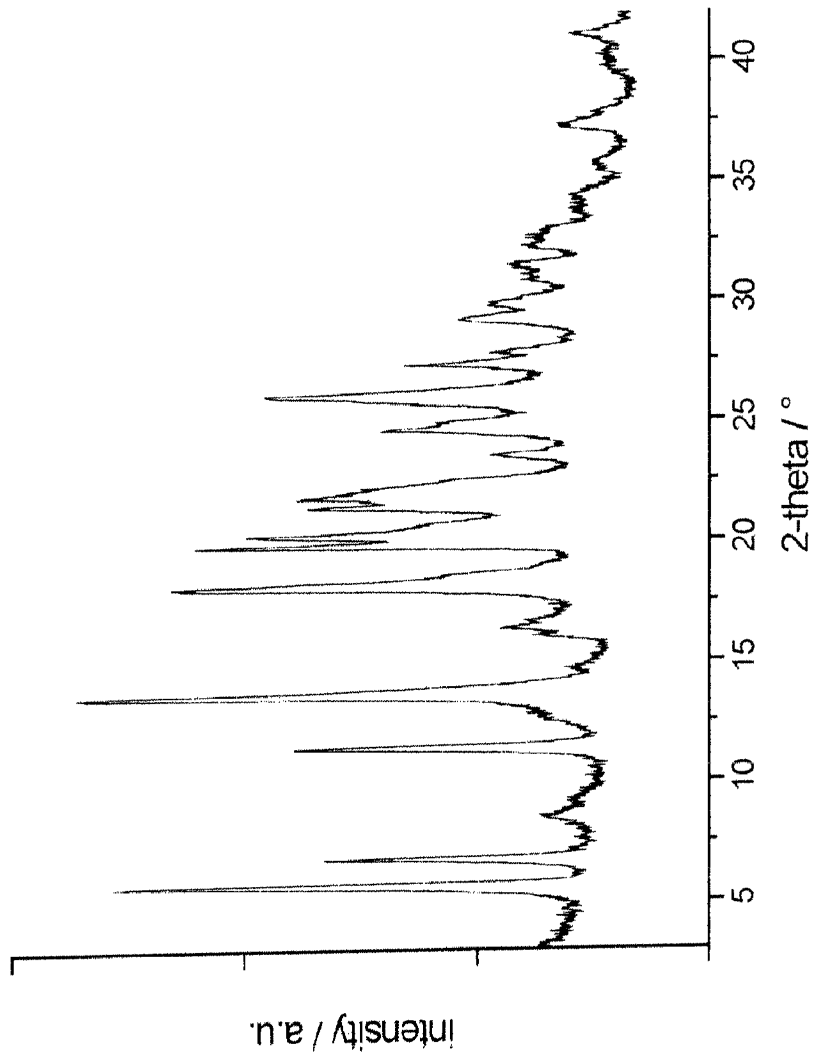


Fig. 18

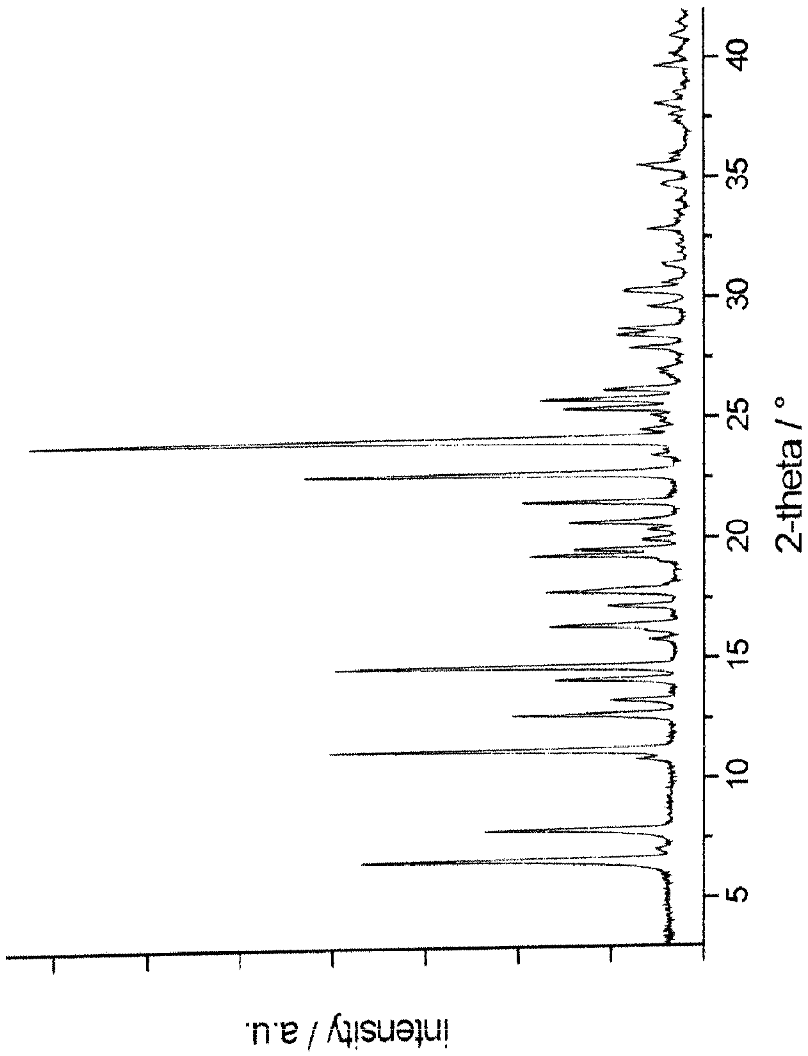


Fig. 19

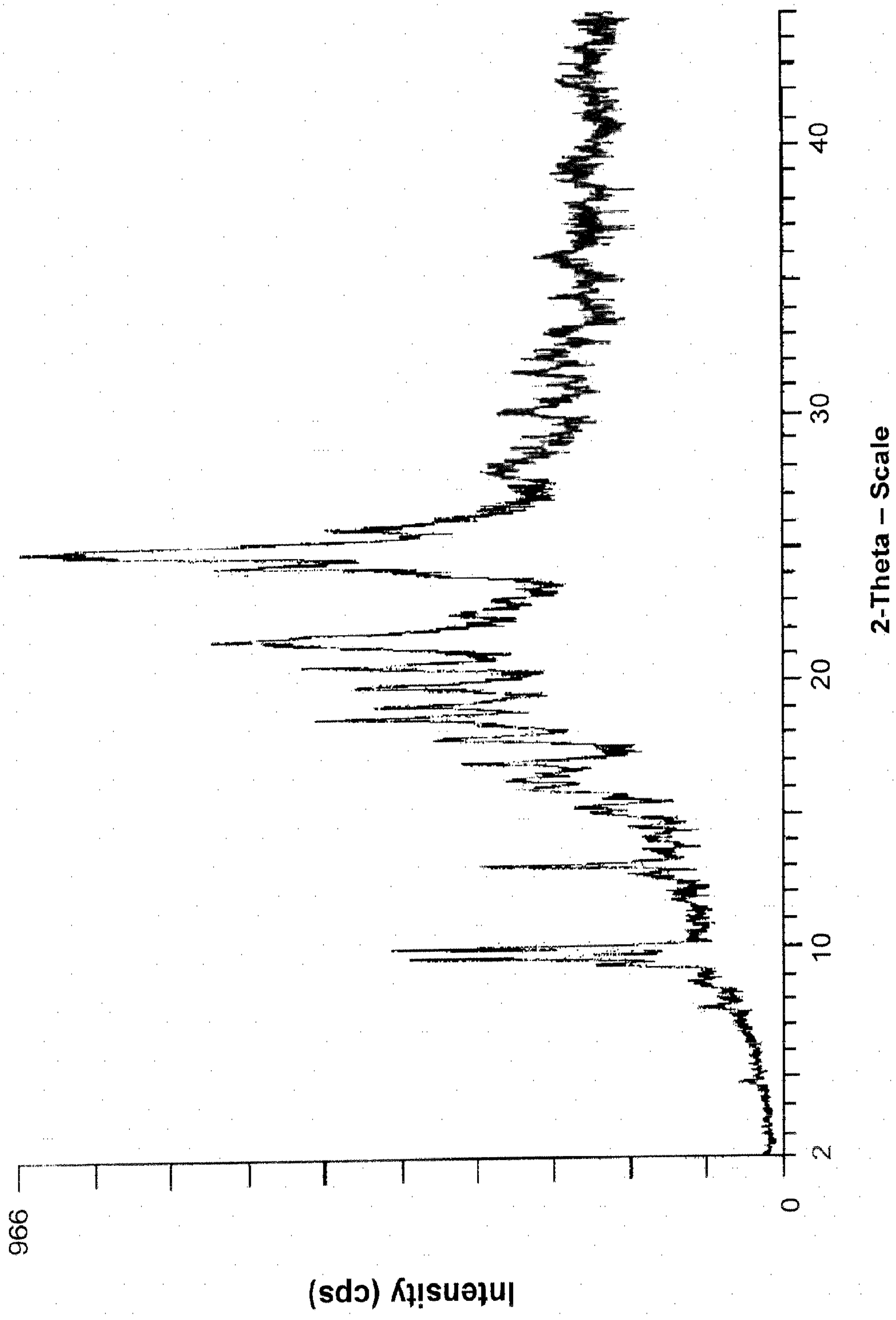


Fig. 20

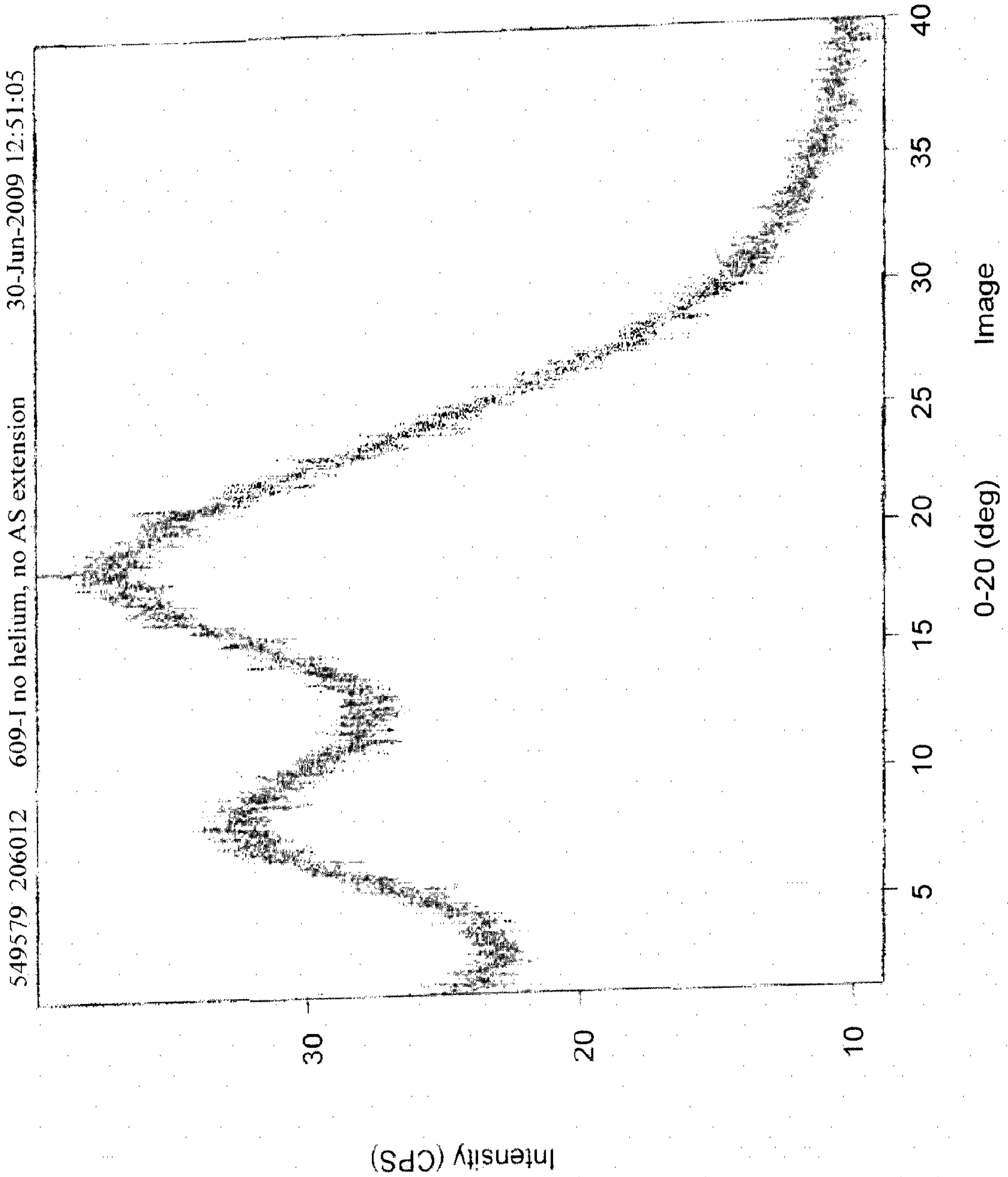

549579 206012 609-I no helium, no AS extension 30-Jun-2009 12:51:05
Intensity (CPS)
30
20
10
5
10
15
20
25
30
35
40
0-20 (deg)
Image

Fig. 21

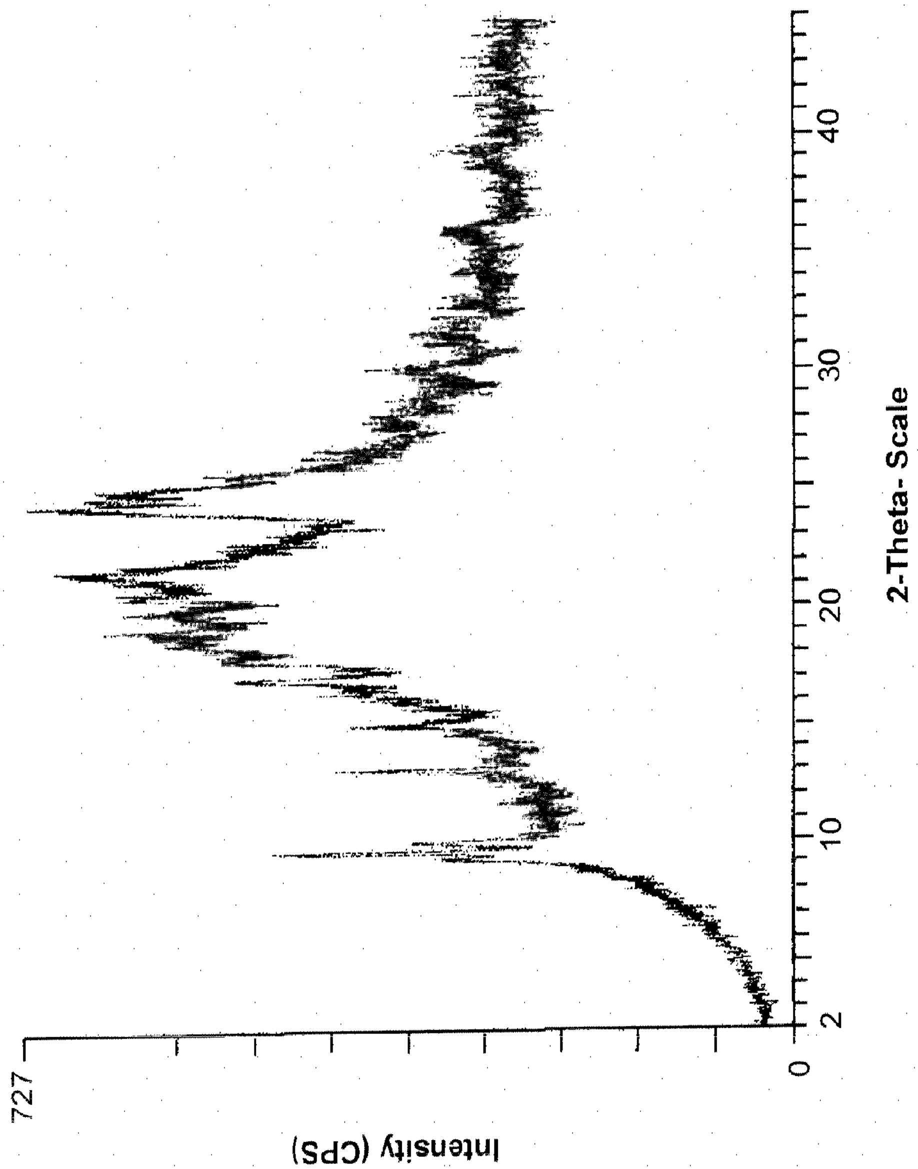


Fig. 22

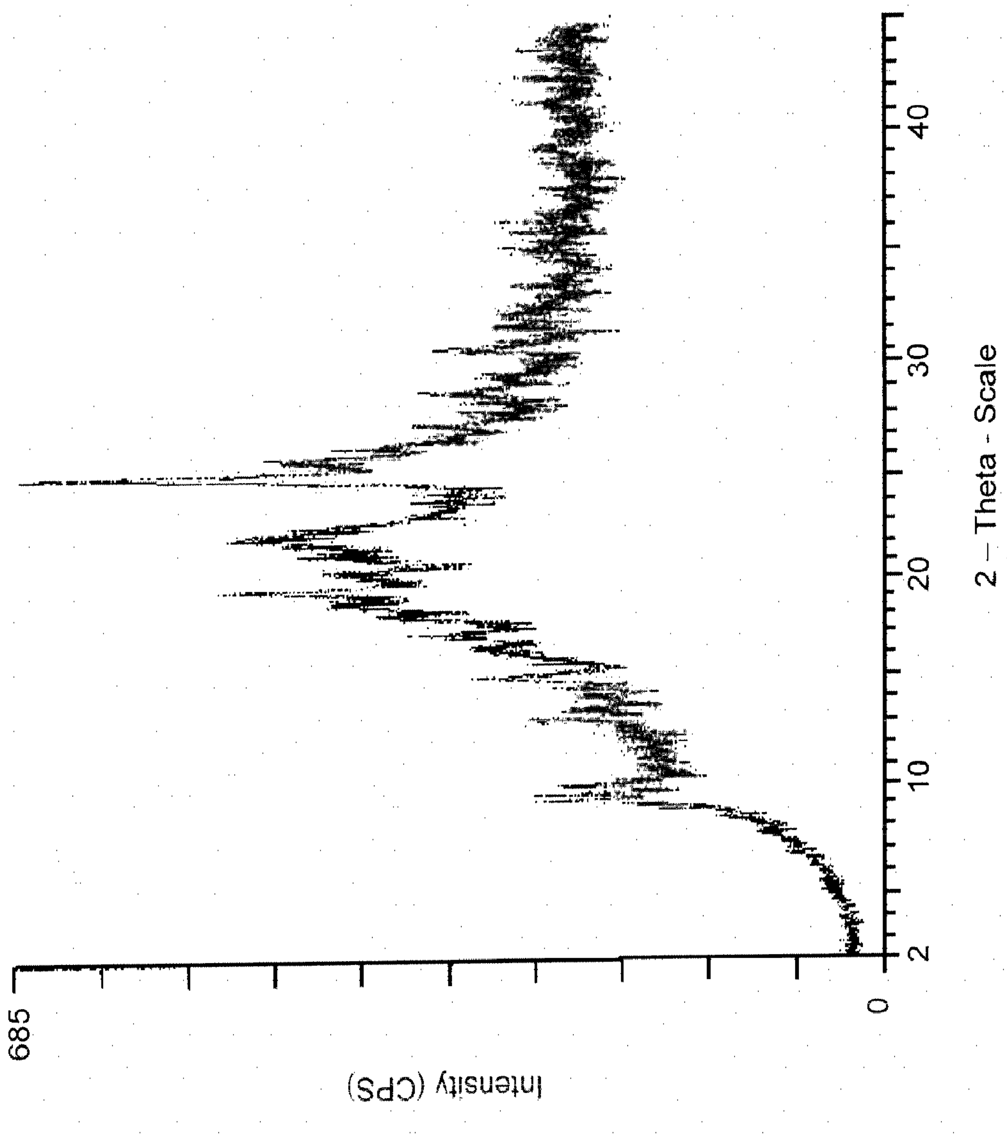


Fig. 23

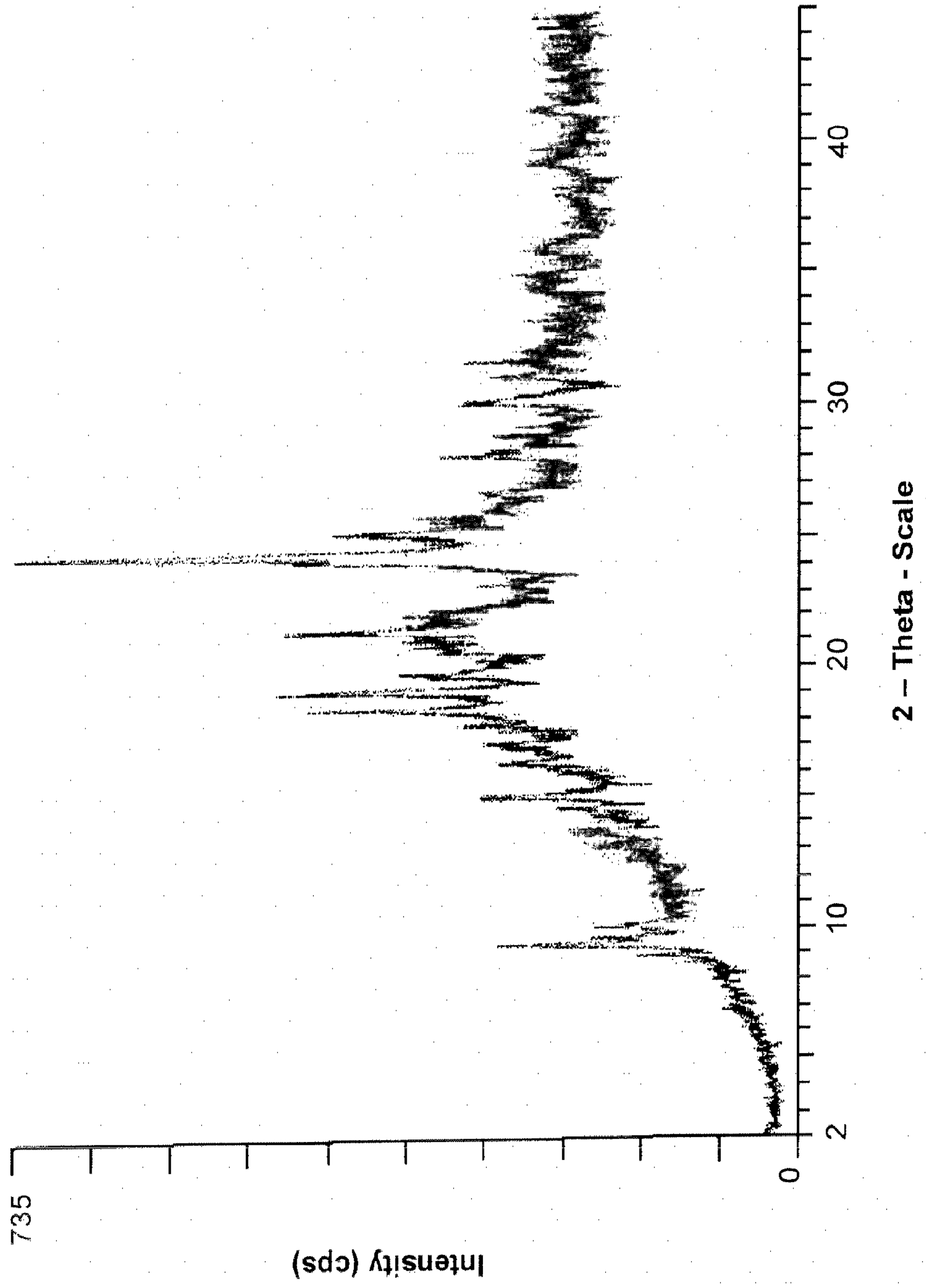


Fig. 24

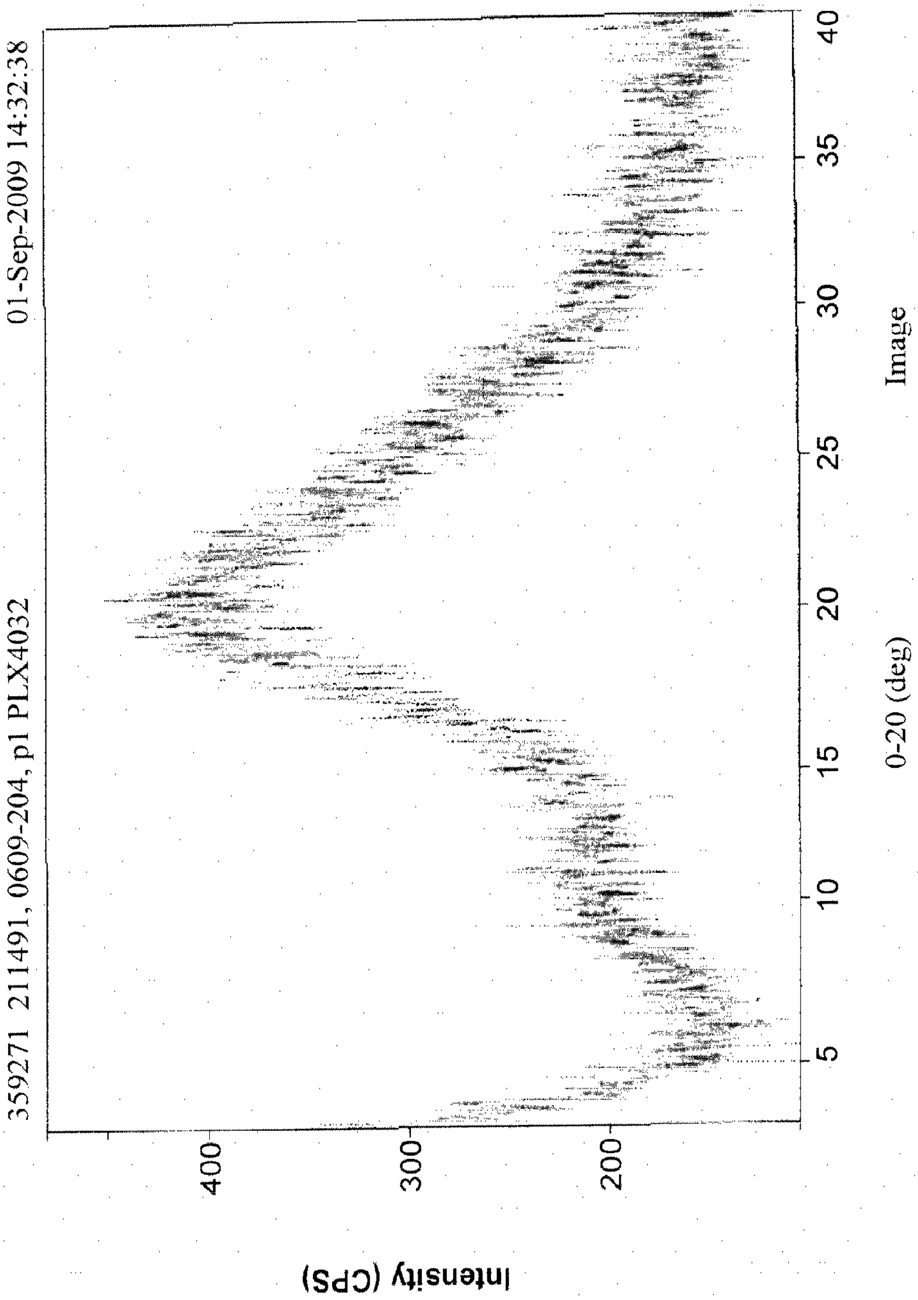

359271 211491, 0609-204, p1 PLX4032
01-Sep-2009 14:32:38
Intensity (CPS)
400
300
200
5
10
15
20
25
30
35
40
0-20 (deg)
Image

Fig. 25

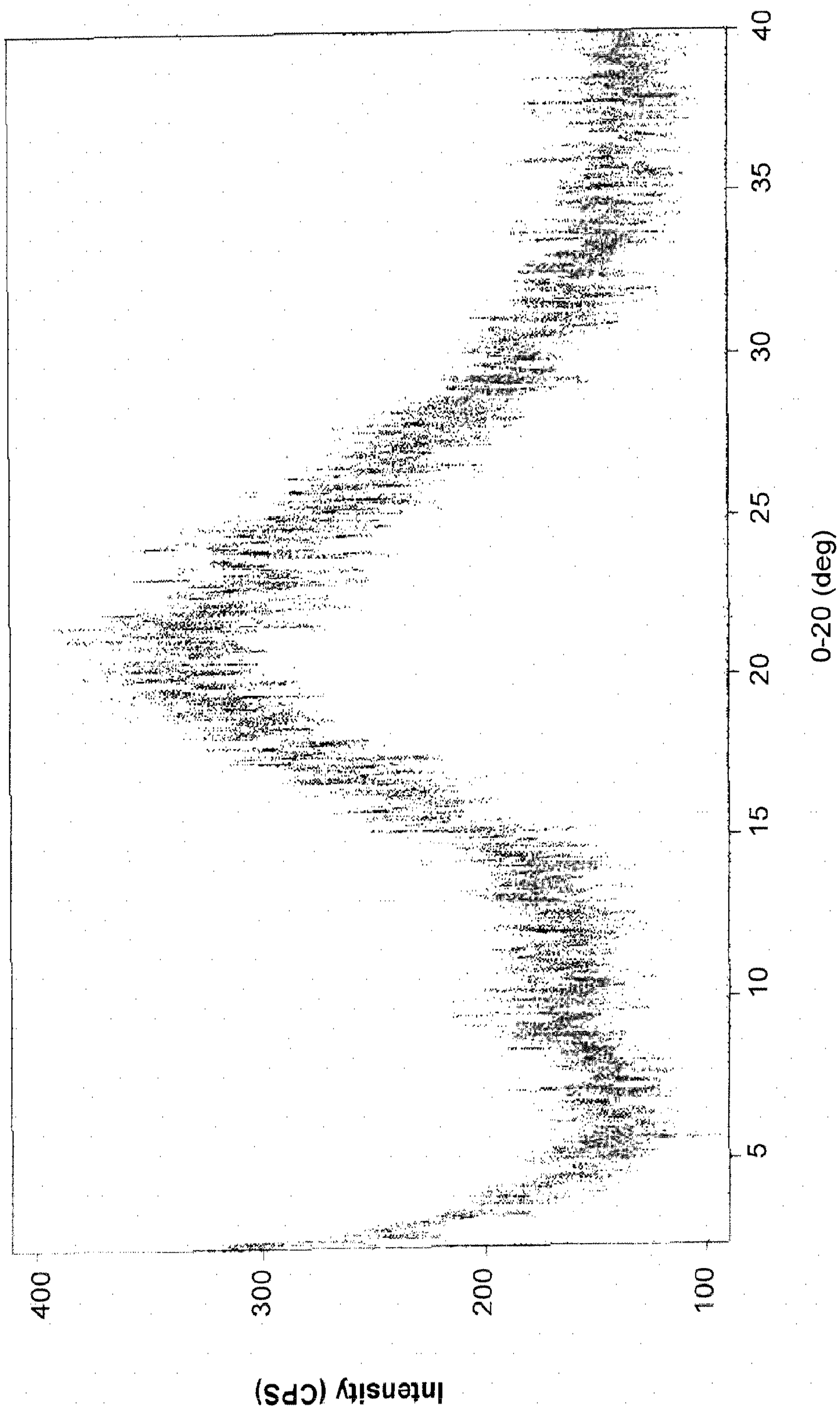


Fig. 26

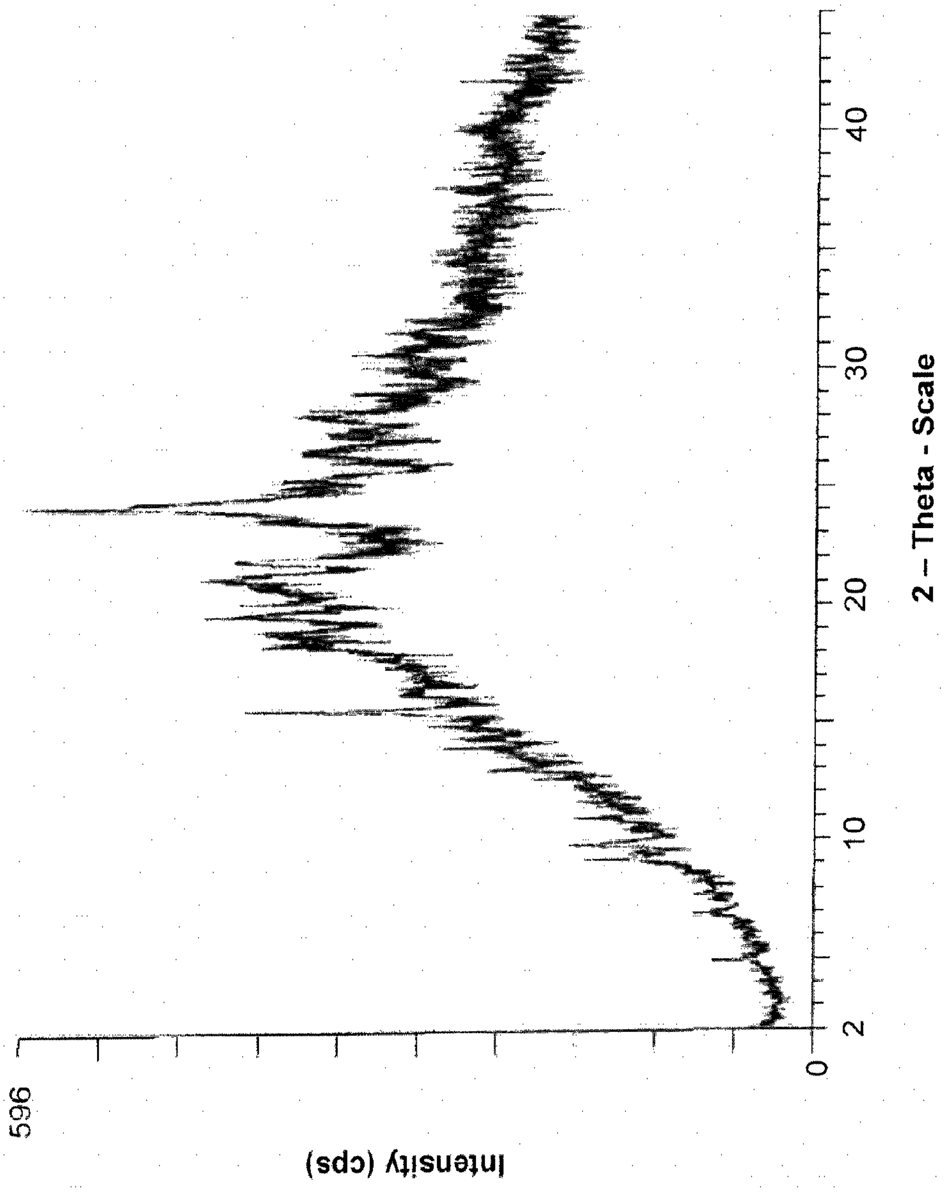


Fig. 27

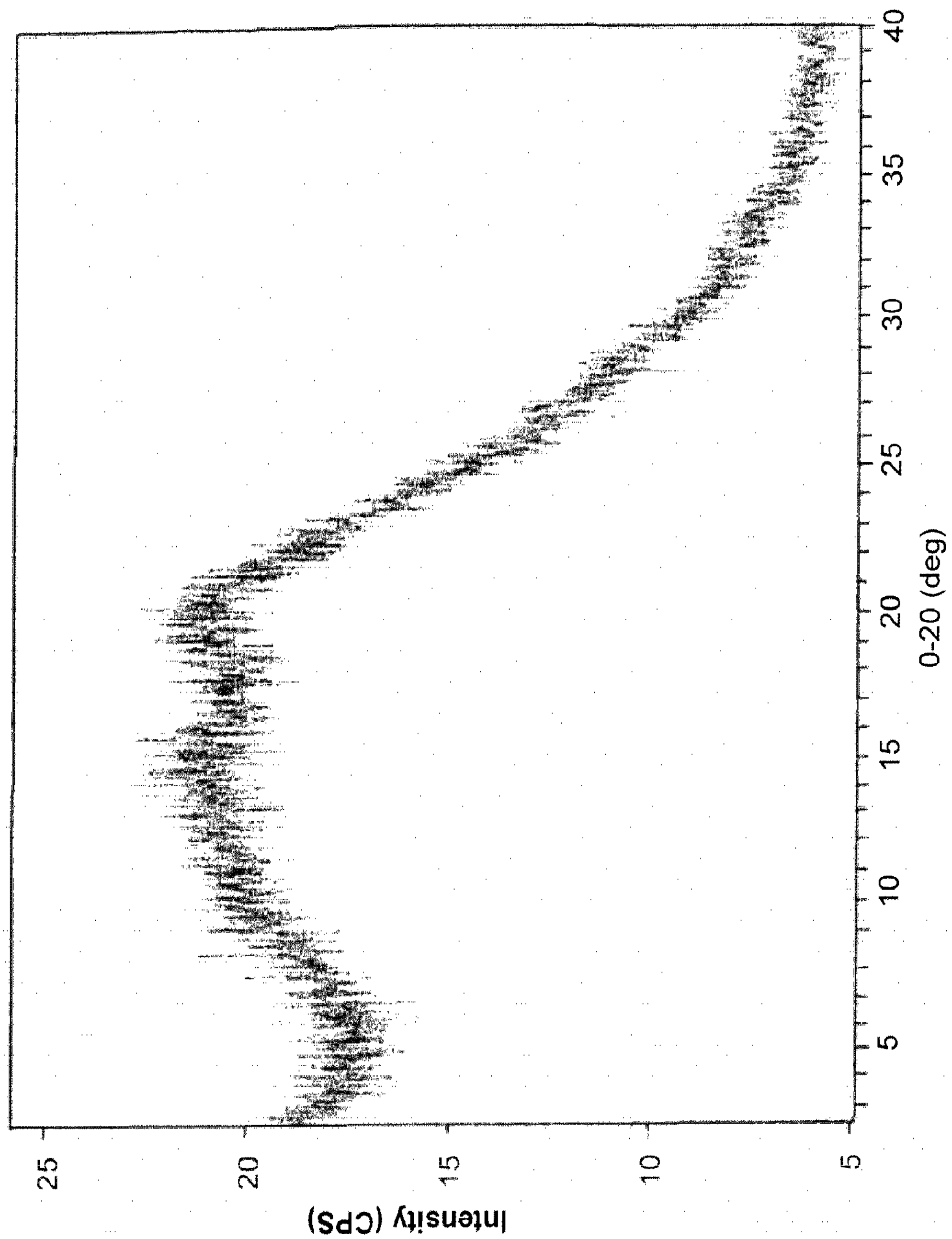


Fig. 28

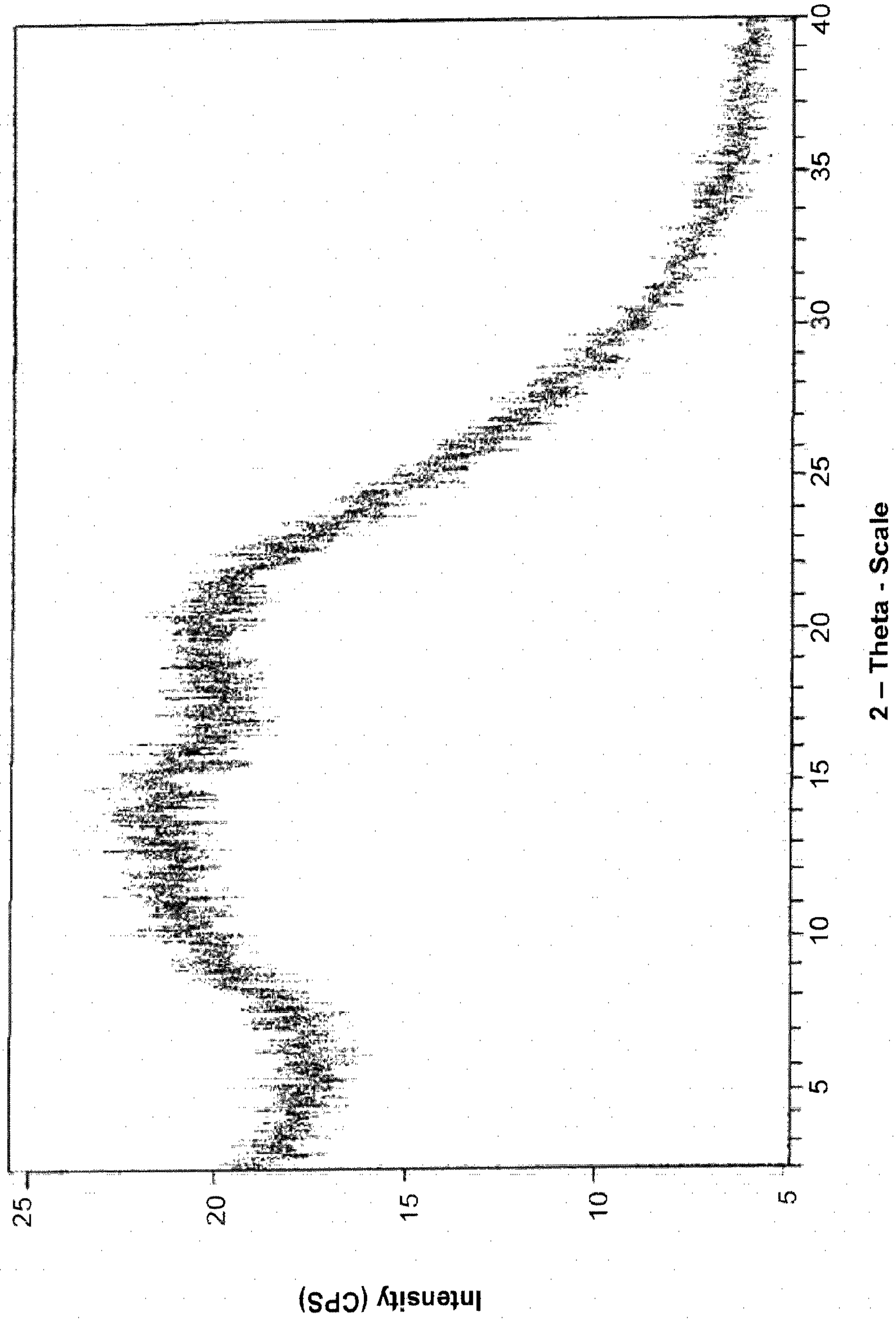


Fig. 29

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/025965

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61P 35/00 (2012.01)
USPC - 514/274
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A61K 9/14, 31/437, 31/5377; A61P 13/12, 19/02, 25/00, 25/04, 29/00, 35/00; C07D 471/04 (2012.01)
USPC - 424/486; 514/47, 234.2, 234.200P, 234.5, 249, 249P, 256, 274, 275; 544/316

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Google, Google Patents, PubMed

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/0310659 A1 (DESAI et al) 09 December 2010 (09.12.2010) entire document	1-10, 13, 20, 36-39
A	WO 2007/002433 A1 (IBRAHIM et al) 04 January 2007 (04.01.2007) entire document This document can be viewed by entering the doc number at the following url: http://worldwide.espacenet.com/numberSearch?locale=en_EP	1-13, 18-39
A	Ivanisevic et al. Uses of X-Ray Powder Diffraction In the Pharmaceutical Industry. Pharm Sci Encyc DDDM. 1-42. 2010. [retrieved on 2012-05-21]. Retrieved from Google: <URL: http://www.pharmaquality.com/Media/PublicationsArticle/Xray-diffraction-PFQ-AM11.pdf > entire document	1-13, 18-39

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 May 2012	31 MAY 2012

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/025965

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 40
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claim 40 has been held as an omnibus claim, as it claims an invention including "...compositions containing them and uses as described herein before."

3. ☒ Claims Nos.: 14-17
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.