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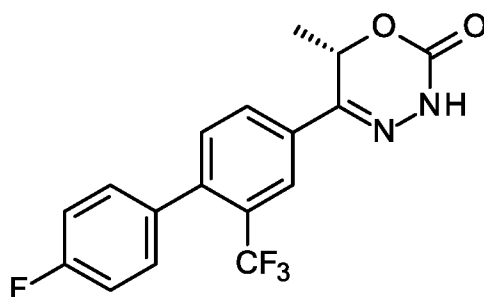
(54) Title: CRYSTALLINE FORMS OF (6S)-5-[4'-FLUORO-2-(TRIFLUOROMETHYL)BIPHENYL-4-YL]-6-METHYL-3,6-DIHYDRO-2H-1,3,4-OXADIAZIN-2-ONE

(57) Abstract: This present invention relates to a crystalline form of (6S)-5-[4'-Fluoro-2- (trifluoromethyl)biphenyl-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one which is the polymorph C, to processes for its preparation, to pharmaceutical compositions comprising it and to its use in the treatment of disorders.

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Crystalline forms of (6S)-5-[4'-Fluoro-2-(trifluoromethyl)biphenyl-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one

This present invention relates to the crystalline form of (6S)-5-[4'-Fluoro-2-(trifluoromethyl)biphenyl-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one which is the polymorph C, to processes for its preparation, to pharmaceutical compositions comprising it and to its use in the control of disorders. (6S)-5-[4'-Fluoro-2-(trifluoromethyl)biphenyl-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one corresponds to the compound of formula (I):



(I).

BACKGROUND

This compound is first disclosed in WO2019/025562, example 135. No information about its solid state nor a hint that the compound even existed in different modifications was provided therein.

Its crystalline form A and its crystalline form B are published.

The following crystalline forms of the compound of formula (I) have been identified which are polymorph A, polymorph B, and the pseudopolymorphs which are the formamide solvate and a sulfolane solvate. Both polymorphic forms A and B could be obtained by following the synthesis as described in WO2019/025562 either as single modification or as a mixture thereof. In this context the terms “crystalline forms”, “modifications”, “polymorphic forms”, and “polymorphs” have the same meaning. In addition the amorphous form exists. All together – the modifications, the pseudopolymorphs and the amorphous form – are different solid forms of the compound of formula (I).

SUMMARY

Now in addition polymorph C of the compound of the formula (I) has been identified which seems to be the thermodynamically stable form between 0°C and 80°C. It was obtained for the first time by having used the already published synthesis, formerly leading to polymorphic forms A and/or B having by

incident stored the product for quite some time at room temperature and having recrystallized the product thereafter. Surprisingly polymorph C of the compound of formula (I) was identified and it was discovered that polymorph C shows beneficial properties over the other known solid forms of the compound of formula (I) with regard to its habitus, particle size distribution, its bulk density, storage volume and storage stability.

Polymorph C is therefore suitable and preferred over the other solid forms of the compound of formula I for use in the pharmaceutical field, in particular better suitable for preparation of pharmaceutical compositions and for the pharmaceutical preparations themselves.

In particular the use of polymorph C of the compound of formula (I) ensures that an undesired conversion into another form of the compound of formula (I) and an associated change in the properties as described above is prevented. This increases the safety and quality of compositions, preparations and formulations comprising the compound of the formula (I) and the risk to the patient is reduced.

A pharmaceutical composition according to the present invention comprises polymorph C of the compound of formula (I) and optionally further pharmaceutically acceptable excipients.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1: X-Ray powder diffractogram of polymorph C, as obtained in example 1.5

Figure 2: X-Ray powder diffractogram of polymorph C, as obtained in example 1.5, second batch which is one of the other five batches, which were combined for micronization.

Figure 3: X-Ray powder diffractogram of polymorph A, as obtained in example 1.6

Figure 4: X-Ray powder diffractogram of polymorph B, the product obtained in example 1.7

Figure 5: X-Ray powder diffractogram of polymorph B, the product obtained in example 1.8, 1)

Figure 6: X-Ray powder diffractogram of polymorph C, the product obtained in example 1.8, 2)

Figure 7: X-Ray powder diffractogram of polymorph A, the product as obtained in example 2.1, table in example 3.1

Figure 8: X-Ray powder diffractogram of polymorph B, the product as obtained in example 2.2, table in example 3.1

Figure 9: X-Ray powder diffractogram of polymorph C, the product as obtained in example 2.3, table in example 3.1

Figure 10: IR Spectrum of polymorph A as obtained in example 2.1, table in example 3.2

Figure 11: IR Spectrum of polymorph B as obtained in example 2.2, table in example 3.2

Figure 12: IR Spectrum of polymorph C as obtained in example 2.3, table in example 3.2

Figure 13: Raman Spectrum of polymorph A as obtained in example 2.1, table in example 3.3

Figure 14: Raman Spectrum of polymorph B as obtained in example 2.2, table in example 3.3

5 Figure 15: Raman Spectrum of polymorph C as obtained in example 2.3, table in example 3.3

Figure 16: DSC- and TGA-thermogram of polymorph A as obtained in example 3.4 showing Heat Flow Endo up [mW] vs Temperature [°C] as the peak curve and the red line curve reflects Weight % [%] vs temperature

10 Figure 17: DSC- and TGA thermogram of polymorph B as obtained in example 3.4 showing heat flow endo up [mW] vs temperature [°C] as the peak curve and the red line curve reflects weight % [%] vs temperature

Figure 18: DSC- and TGA thermogram of polymorph C as obtained in example 3.4 showing heat flow endo up [mW] vs temperature [°C] as the peak curve and the red line curve reflects weight % [%] vs temperature

15 Figure 19A: Schulze Ring Shear Tester device

Figure 19B: Shear Cell XS-SV3 belonging to the Schulze Ring Shear Tester device of figure 19A

Figure 20: Result of the Schulze Ring Shear Test for probe 1 (polymorph A), obtained in example 1.6 and probe 2 (polymorph C) obtained in example 1.5.

20 Figure 21: Illustration of the flow factors of polymorph A and polymorph C calculated on basis of the results of the Schulze Ring Shear Test according to example 3.

Figure 22: Result of the determination of bulk density during shear test, see example 4. Bulk density of sample 2 (Probe 2) is significantly higher than bulk density of sample 1 (Probe 1).

Figure 23: Comparison of particle size distribution of polymorph A (sample 1) and C (sample 2), see example 5, each sample without ("ohne") and with 300 s of ultrasound treatment

25 Figure 24A: Particle size distribution of polymorph A without- and under ultrasound treatment, see example 5, "Fraunhofer Auswertung" means Fraunhofer Analysis Method

Figure 24B: Particle size distribution of polymorph C without- and under ultrasound treatment, see example 5, "Fraunhofer Auswertung" means Fraunhofer Analysis Method

DETAILED DESCRIPTION

A preferred embodiment of the present invention is a pharmaceutical composition comprising mainly polymorph C of the compound of formula (I) and no significant fractions of another form of the compound of formula (I) and optionally further pharmaceutically acceptable excipients. More preferably the pharmaceutical composition contains more than 85 percent, more preferably more than 90 percent, most preferably more than 95 percent, of the polymorph C of the compound of formula (I) related to the total amount of all forms of the compound of formula (I) present in the composition. A significant fraction of another polymorph than polymorph C is considered 15 % or more.

The different forms of the compound of formula (I) can be distinguished by X-Ray powder diffraction, IR-, Raman spectroscopy and differential scanning calorimetry (DSC),

X-Ray powder diffractograms

The polymorph C of the compound of formula (I) can be characterized unambiguously by a X-Ray powder diffractogram (at 25°C and with Cu-K alpha 1 as radiation source) which displays at least the following reflections: 21,1; 15,1; 22,6; preferably at least the following reflections: 21,1; 15,1; 22,6; 18,8; 26,8; more preferably at least the following reflections: 21,1; 15,1; 22,6; 18,8; 26,8; 22,6; 18,9; most preferably at least the following reflections: 21,1; 15,1; 22,6; 18,8; 26,8; 22,6; 18,9; 29,8; 11,9; 31,6; each quoted as $^{\circ}2\theta$ value $\pm 0.2^{\circ}$. The compound of formula (I) in the polymorph C can also be characterized unambiguously by the X-Ray powder diffractogram (at 25°C and with Cu-K alpha 1 as radiation source) as shown in Figure 1. The reflections as disclosed above are ordered by their intensity starting with the most intense peak.

In one embodiment the reflections of polymorph C as shown above are the 3, 5 or 7 most intense reflections.

In one embodiment the reflections of polymorph C as shown above are the 3, 5, 7 or 10 most intense reflections.

The polymorph B of the compound of formula (I) can be characterized unambiguously by a X-Ray powder diffractogram (at 25°C and with Cu-K alpha 1 as radiation source) which displays at least the following reflections: 20,5; 20,8; 16,9; preferably at least the following reflections: 20,5; 20,8; 16,9; 21,5; 23,7; more preferably at least the following reflections: 20,5; 20,8; 16,9; 21,5; 23,7; 14,4; 26,8; most preferably at least the following reflections: 20,5; 20,8; 16,9; 21,5; 23,7; 14,4; 26,8; 27,2; 16,7; 12,4; each quoted as $^{\circ}2\theta$ value $\pm 0.2^{\circ}$. The compound of formula (I) in the polymorph B can also be characterized unambiguously by the X-Ray powder diffractogram (at 25°C and with Cu-K alpha 1 as radiation source) as shown in Figure 2. The reflections as disclosed above are ordered by their intensity starting with the most intense peak.

The polymorph A of the compound of formula (I) can be characterized unambiguously by a X-Ray powder diffractogram (at 25°C and with Cu-K alpha 1 as radiation source) which displays at least the following reflections: 20,7; 20,5; 12,3 preferably at least the following reflections: 20,7; 20,5; 12,3; 17,0; 23,9; more preferably at least the following reflections: 20,7; 20,5; 12,3; 17,0; 23,9; 21,0; 27,4; most preferably at least the following reflections: 20,7; 20,5; 12,3; 17,0; 23,9; 21,0; 27,4; 13,9; 21,5; 15,2; each quoted as $^{\circ}2\theta$ value $\pm 0.2^{\circ}$. The compound of formula (I) in the polymorph A can also be characterized unambiguously by the X-Ray powder diffractogram (at 25°C and with Cu-K alpha 1 as radiation source) as shown in Figure 3. The reflections as disclosed above are ordered by their intensity starting with the most intense peak.

10 IR spectra

The polymorph C of the compound of formula (I) can be characterized unambiguously by IR spectroscopy using an ATR (attenuated total reflection) unit without sample preparation which displays at least the following bands: 1123, 837, 1285 [cm^{-1}], preferably at least the following bands: 1123, 837, 1285, 678, 1164 [cm^{-1}], more preferably at least the following bands: 1123, 837, 1285, 678, 1164, 1730, 1049 [cm^{-1}], most preferably at least the following bands: 1123, 837, 1285, 678, 1164, 1730, 1049, 1175, 659 [cm^{-1}], each quoted as band maxima $\pm 2 \text{ cm}^{-1}$. The compound of formula (I) in the polymorph C can also be characterized unambiguously by the IR spectrum (using an ATR unit without sample preparation) as shown in Figure 5.

The polymorph B of the compound of formula (I) can be characterized unambiguously by IR spectroscopy (using an ATR unit without sample preparation) which displays at least the following bands: 833, 1059, 1128 [cm^{-1}], preferably at least the following bands: 833, 1059, 1128, 1274, 661 [cm^{-1}], more preferably at least the following bands: 833, 1059, 1128, 1274, 661, 1732, 656 [cm^{-1}], most preferably at least the following bands: 833, 1059, 1128, 1274, 661, 1732, 656, 591, 907, 724 [cm^{-1}], each quoted as band maxima $\pm 2 \text{ cm}^{-1}$. The compound of formula (I) in the polymorph B can also be characterized unambiguously by the IR spectrum (using an ATR unit without sample preparation) as shown in Figure 6.

The polymorph A of the compound of formula (I) can be characterized unambiguously by IR spectroscopy (at using an ATR unit without sample preparation) which displays at least the following bands: 1123, 1063, 1275 [cm^{-1}], preferably at least the following bands: 1123, 1063, 1275, 1732, 834 [cm^{-1}], more preferably at least the following bands: 1123, 1063, 1275, 1732, 834, 829, 656 [cm^{-1}], most preferably at least the following bands: 1123, 1063, 1275, 1732, 834, 829, 656, 908, 1175, 717 [cm^{-1}], each quoted as band maxima $\pm 2 \text{ cm}^{-1}$. The compound of formula (I) in the polymorph A can also be characterized unambiguously by the IR spectrum (using an ATR unit without sample preparation) as shown in Figure 7.

Raman spectra

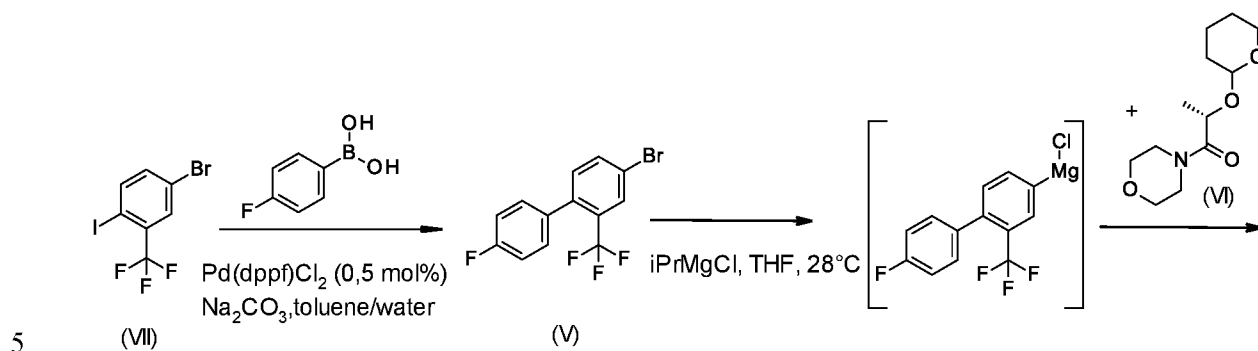
The polymorph C of the compound of formula (I) can be characterized unambiguously by Raman spectroscopy (at 25°C using a 1064 nm NdYAG Laser) which displays at least the following bands: 1606, 1617, 141 [cm⁻¹], preferably at least the following bands: 1606, 1617, 141, 92, 1272 [cm⁻¹], more preferably at least the following bands: 1606, 1617, 141, 92, 1272, 120, 1328 [cm⁻¹], most preferably at least the following bands: 1606, 1617, 141, 92, 1272, 120, 1328, 812, 1095, 1298 [cm⁻¹], each quoted as band maxima ± 2 cm⁻¹. The compound of formula (I) in the polymorph C can also be characterized unambiguously by the Raman spectrum (at 25°C using a 1064 nm NdYAG Laser) as shown in Figure 8.

The polymorph B of the compound of formula (I) can be characterized unambiguously by Raman spectroscopy (at 25°C using a 1064 nm NdYAG Laser) which displays at least the following bands: 1610, 1252, 815 [cm⁻¹], preferably at least the following bands: 1610, 1252, 815, 1070, 1449 [cm⁻¹], more preferably at least the following bands: 1610, 1252, 815, 1070, 1449, 1339, 1464 [cm⁻¹], most preferably at least the following bands: 1610, 1252, 815, 1070, 1449, 1339, 1464, 1300, 1432, 1632 [cm⁻¹], each quoted as band maxima ± 2 cm⁻¹. The compound of formula (I) in the polymorph B can also be characterized unambiguously by the Raman spectrum (at 25°C using a 1064 nm NdYAG Laser) as shown in Figure 9.

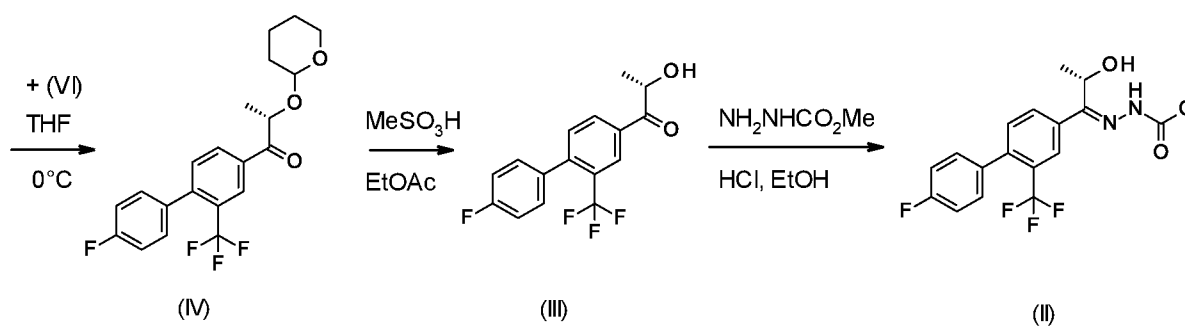
The polymorph A of the compound of formula (I) can be characterized unambiguously by Raman spectroscopy (at 25°C using a 1064 nm NdYAG Laser) which displays at least the following bands: 1612, 1252, 815 [cm⁻¹], preferably at least the following bands: 1612, 1252, 815, 1070, 1433 [cm⁻¹], more preferably at least the following bands: 1612, 1252, 815, 1070, 1433, 1447, 1463 [cm⁻¹], most preferably at least the following bands: 1612, 1252, 815, 1070, 1433, 1447, 1463, 1286, 1107, 139 [cm⁻¹], each quoted as band maxima ± 2 cm⁻¹. The compound of formula (I) in the polymorph A can also be characterized unambiguously by the Raman spectrum (at 25°C using a 1064 nm NdYAG Laser) as shown in Figure 10.

Process for preparing:

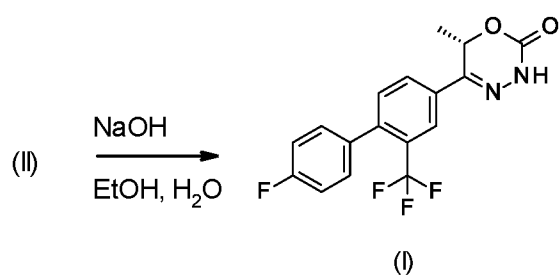
The compound of formula (I) can be prepared according to the methods disclosed in WO2019/025562 or following the route as described in Schemes 1a-c below:



Scheme (Ia)



Scheme (Ib)



Scheme (Ic)

Schemes (Ia-Ic): *Convergent synthesis of the compound of formula (I)*

This synthesis is reflected in the experimental section.

Definitions

The terms “sample” and “probe” are used synonymously herein.

The terms “crystalline forms”, “forms” “modifications”, “polymorphic forms”, and “polymorphs” have the same meaning.

- 5 “Another form” of a compound of formula (I) in a composition comprising mainly polymorph C can be any other polymorphic form than C, especially polymorph A or polymorph B. And if the plural term “other forms” is used it can also comprise mixtures of any of the polymorphic forms , especially mixtures of polymorph A and B besides C.

- 10 A significant fraction of another polymorphic form than polymorph C in a sample is considered 15 % per weight or more.

Method for treatment

The crystalline forms of the compound of formula (I), preferably polymorph C according to the invention may have useful pharmacological properties and may be employed for the prevention and treatment of disorders in humans and animals.

- 15 The crystalline form C of the compound of formula (I) according to the invention can be used for the treatment of hyperproliferative diseases, especially cancer, more especially where the cancer disease occurs in the following organs: anus, the brain, the breast, the bones, the central and peripheral nervous system, the colon, the eye, the kidney, the endocrine glands (e.g., thyroid and adrenal cortex), the endometrium, the esophagus, the gastrointestinal tract (including gastrointestinal stromal tumors),the
20 germ cells, the head and the neck, the kidney, the liver, the larynx and hypopharynx, the lung, the mesothelioma, the pancreas, the prostate, the rectum, the reproductive organs (e.g., cervix, ovary, prostate), the respiratory tract, the small intestine, the skin, the soft tissue, the stomach, the testis, the thyroid gland, the parathyroid gland, ureter, the urogenital tract, vagina and vulva and the connective tissue, including their metastases.
- 25 A preferred list of tumors for treatment of cancer are those occurring in the brain, female reproductive tract, especially ovary, and skin, and including sarcoma.

Examples of breast cancers include, but are not limited to, invasive ductal carcinoma, invasive lobular carcinoma, ductal carcinoma in situ, and lobular carcinoma in situ.

- 30 Examples of “brain cancers” include, but are not limited to, brain stem and hypophthalmic glioma, cerebellar and cerebral astrocytoma, medulloblastoma, ependymoma, as well as neuroectodermal and pineal tumour.

Tumors of the “central nervous system” include according to the WHO listing, but are not limited to, tumors of neuroepithelial tissue (e.g. astocytic tumors, gliomas), oligodentromial tumors, glioneuronal tumors and neuronal tumors, choroid plexus tumors, pineal tumors, cranial and paraspinal nerve tumors, melanocytic tumors, hematolymphoid tumors.

- 5 Tumours of the “digestive tract” include, but are not limited to, anal, colon, colorectal, oesophageal, gallbladder, gastric, pancreatic, rectal, small-intestine, and salivary gland cancers.

“Eye cancers” include, but are not limited to, intraocular melanoma and retinoblastoma.

“Head-and-neck cancers” include, but are not limited to, laryngeal, hypopharyngeal, nasopharyngeal, oropharyngeal cancer, lip and oral cavity cancer and squamous cell.

- 10 Examples of “liver cancers” include, but are not limited to, hepatocellular carcinoma (liver cell carcinomas with or without fibrolamellar variant), cholangiocarcinoma (intrahepatic bile duct carcinoma), and mixed hepatocellular cholangiocarcinoma.

Examples of cancers of the “respiratory tract” include, but are not limited to, small-cell and non-small-cell lung carcinoma, as well as bronchial adenoma and pleuropulmonary blastoma.

- 15 “Reproductive organs” include female- and male reproductive organs.

“Tumours of the female reproductive organs” include, but are not limited to, endometrial, cervical, ovarian, vaginal, and vulvar cancer, as well as sarcoma of the uterus. “Tumours of the male reproductive organs” include, but are not limited to, prostate and testicular cancer.

- 20 “Skin cancers” include, but are not limited to, squamous cell carcinoma, Kaposi’s sarcoma, malignant melanoma (melanoma), Merkel cell skin cancer, and non-melanoma skin cancer.

“Tumours of the urinary tract” include, but are not limited to, bladder, penile, kidney, renal pelvis, ureter, urethral and human papillary renal cancers.

- 25 “Lymphomas” include, but are not limited to, AIDS-related lymphoma, non-Hodgkin’s lymphoma, cutaneous T-cell lymphoma, Burkitt lymphoma, Hodgkin’s disease, and lymphoma of the central nervous system.

“Sarcomas” include, but are not limited to, sarcoma of the soft tissue, osteosarcoma, malignant fibrous histiocytoma, lymphosarcoma, and rhabdomyosarcoma.

“Leukemias” include, but are not limited to, acute myeloid leukemia (AML), acute lymphoblastic leukemia, chronic lymphocytic leukemia, chronic myelogenous leukemia, and hairy cell leukemia.

The crystalline form C of the compound of formula (I) according to the invention can furthermore be used for the treatment of a hyperproliferative disease, especially a cancer diseases, such as e.g. brain cancer, breast cancer, cervical cancer, head and neck cancer, leukemia, acute myeloid leukemia (AML), lung cancer (especially NCLC and SCLC), lymphoma, skin cancer (especially melanoma), esophageal carcinoma, ovarian cancer, pancreas cancer, prostate cancer and sarcoma.

In other embodiments the invention relates to the crystalline form C of the compound of formula (I) for use in the treatment and/or prophylaxis of diseases, especially hyperproliferative diseases, more especially cancer diseases.

In other embodiments the invention relates to the crystalline form C of the compound of formula (I) for use in the treatment and/or prophylaxis of diseases whereby the disease is a cancer disease which is selected from brain cancer, breast cancer, cervical cancer, head and neck cancer, leukemia, AML, lung cancer, lymphoma, skin cancer, esophageal carcinoma, ovarian cancer, pancreas cancer, prostate cancer and sarcoma.

In other embodiments the invention relates to the crystalline form C of the compound of formula (I) for use in the manufacture of a pharmaceutical composition for the treatment or prevention of a disease, especially a hyperproliferative disease, more especially a cancer disease, and yet even more especially a cancer disease selected from e.g. brain cancer, breast cancer, cervical cancer, head and neck cancer, leukemia, AML, lung cancer, lymphoma, skin cancer, esophageal carcinoma, ovarian cancer, pancreas cancer, prostate cancer and sarcoma.

Other embodiments of the invention include the crystalline form C of the compound of formula (I) for use in the manufacture of a stable pharmaceutical composition.

Further embodiments of the invention include a method of treating or preventing a hyperproliferative diseases, more especially a cancer disease, and yet even more especially a cancer disease selected from e.g. brain cancer, breast cancer, cervical cancer, head and neck cancer, leukemia, AML, lung cancer, lymphoma, skin cancer, esophageal carcinoma, ovarian cancer, pancreas cancer, prostate cancer and sarcoma in a mammal, comprising administering to a mammal in need thereof a therapeutically effective amount of polymorph C of the compound of formula (I).

In some embodiments, the present invention further relates to a method for the treatment and/or prophylaxis of diseases, in particular the aforementioned diseases, using an effective amount of at least one of the forms of the compound of formula (I) according to the invention, especially of polymorph C.

In some embodiments, the present invention further relates to a method for the treatment and/or prophylaxis of a hyperproliferative disease using an effective amount of at least one of the forms of the

compound of formula (I) according to the invention, especially polymorph C, preferably the present invention further relates to a method for the treatment and/or prophylaxis of a cancer disease.

Combination

The crystalline forms of the compound of formula (I) according to the invention can be used alone or in combination with other active substances if necessary. The present invention further relates to medicinal products containing at least one of the forms of the compound of formula (I) according to the invention and one or more further active substances, in particular an anti-cancer agent, particularly for the treatment and/or prophylaxis of the aforementioned diseases. As suitable other active substances the following anti-cancer-agents can be mentioned:

13II-metuximab, 13II-chTNT, abarelix, abemaciclib, abiraterone, acalabrutinib, aclarubicin, adalimumab, ado-trastuzumab emtansine, afatinib, aflibercept, aldesleukin, alectinib, alfaferone, alemtuzumab, alendronic acid, alitretinoin, almonertinib, alpelisib, alpharadin, monosodium alpha luminol, altretamine, amifostine, aminoglutethimide, hexyl aminolevulinate, aminolevulinic acid, amrubicin, amsacrine, anastrozole, anecstim, anethole dithiolethione, anetumab ravtansine, angiotensin II, antithrombin III, apalutamide, aprepitant, arcitumomab, arglabin, arsenic trioxide, asparaginase, atezolizumab, avapritinib, avelumab, axicabtagene ciloleucel, axitinib, azacitidine, basiliximab, beclomethasone dipropionate, belantamab mafodotin, belinostat, belotecan, bendamustine, besilesomab, beta-elemene, bevacizumab, bexarotene, bicalutamide, binimetinib, bisantrene, bleomycin, blinatumomab, boanmycin hydrochloride, borofalan, bortezomib, bosutinib, budesonide, buserelin, brentuximab vedotin, brigatinib, busulfan, cabazitaxel, cabozantinib, calcitonine, calcium folinate, calcium levofolinate, capecitabine, capmatinib, capromab, carbamazepine, carboplatin, carboquone, carfilzomib, carmofur, carmustine, catumaxomab, catequentinib, celecoxib, celmoleukin, cemiplimab, ceritinib, cetuximab, chlorambucil, chlormadinone, chlormethine, chloroxoquinoline, cidofovir, cinacalcet, cisplatin, cladribine, clodronic acid, clofarabine, cobimetinib, copanlisib, crisantaspase, crizotinib, cyclophosphamide, cyproterone, cytarabine, dacarbazine, dacomitinib, dactinomycin, daratumumab, darbepoetin alfa, dabrafenib, dasatinib, daunorubicin, decitabine, deferasirox, degarelix, denileukin diftitox, denosumab, depreotide, deslorelin, dianhydrogalactitol, dexrazoxane, dibrospidium chloride, dianhydrogalactitol, diclofenac, dinutuximab, docetaxel, dolasetron, doxifluridine, doxorubicin, doxorubicin and estrone, dronabinol, dupilumab, durvalumab, duvelisib, eculizumab, edrecolomab, elliptinium acetate, elotuzumab, eltrombopag, enasidenib, encorafenib, endostatin, enfortumab vedotin, enocitabine, enzalutamide, epirubicin, epitiostanol, epoetin alfa, epoetin beta, epoetin zeta, eptaplatin, eribulin, erlotinib, ensartinib, entrectinib, erdafitinib, esomeprazole, estradiol, estramustine, estrone, ethinylestradiol, etoposide, everolimus, evocalcet, exemestane, fadrozole, famotidine, fentanyl, filgrastim, flumatinib, fluoxymesterone, fluticasone, fluticasone furoate, floxuridine, fludarabine, fluorouracil, flutamide, folinate, folinic acid, formestane, forodesine, fosaprepitant, fotemustine, fruquintinib, fulvestrant, gadobutrol, gadoteridol, gadoteric acid meglumine,

gadoversetamide, gadoxetic acid, gallium nitrate, ganirelix, gefitinib, gemcitabine, gemtuzumab, gendicine, gilteritinib, ginsenoside Rg3, glasdegib, glucarpidase, glutoxim, GM-CSF, goserelin, granisetron, granulocyte colony stimulating factor, hematoporphyrin, histamine dihydrochloride, histrelin, holmium-166-chitosan complex, human menopausal gonadotrophin, hydroxycarbamide, I-125
 5 seeds, lansoprazole, ibandronic acid, ibritumomab tiuxetan, ibrutinib, icotinib hydrochloride, idarubicin, idelalisib, iobenguane (131I), iodine(131I) tumor necrosis factor monoclonal antibody, ifosfamide, imatinib, imiquimod, improsulfan, immunocyanin, indisetron, incadronic acid, indole-3-carbinol and epigallocatechin-3-gallate, ingenol mebutate, inotuzumab ozogamicin, interferon alfa, interferon alpha
 10 1b, interferon-alpha 2, interferon alpha-2a, interferon alpha-2b, interferon beta, interferon gamma, interleukin-2, iobitridol, iobenguane (123I), iomeprol, ipilimumab, irinotecan, Itraconazole, isatuximab, ivosidenib, ixabepilone, ixazomib, lanreotide, lansoprazole, lapatinib, Iasocholine, lenalidomide, lenvatinib, lenograstim, lentinan, letrozole, leuprorelin, levamisole, levonorgestrel, levothyroxine sodium, lisuride, lobaplatin, lomustine, lonidamine, lorlatinib, lurbinctedin, luspatercept, lutetium Lu
 15 177 dotatate, masoprocol, medroxyprogesterone, megestrol, melarsoprol, melphalan, mepitiostane, mercaptamine, mercaptopurine, mesna, methadone, methotrexate, methoxsalen, methylaminolevulinate, methylprednisolone, methyltestosterone, metirosine, midostaurin, mifamurtide, mifepristone, miltefosine, miriplatin, mitobronitol, mitoguazone, mitolactol, mitomycin, mitotane, mitoxantrone, mogamulizumab, molgramostim, mometasone, mopidamol, morphine hydrochloride, morphine sulfate, mvasi, moxetumomab pasudotox, nabilone, nabiximols, nafarelin, naloxone + pentazocine, naltrexone,
 20 nartograstim, natalizumab, necitumumab, nedaplatin, nelarabine, neratinib, neridronic acid, netupitant/palonosetron, nivolumab, pentetreotide, nilotinib, nilutamide, nimorazole, nimotuzumab, nimustine, nintedanib, niraparib, nitracrine, nivolumab, obinutuzumab, octreotide, ofatumumab, olaparib, olaratumab, olmutinib, omacetaxine mepesuccinate, omalizumab, omeprazole, ondansetron, oprelvekin, orelabrutinib, orgotein, orilotinod, osimertinib, oxaliplatin, oxycodone, oxymetholone,
 25 ozogamicine, p53 gene therapy, paclitaxel, padeliporfin, palbociclib, palifermin, palladium-103 seed, palonosetron, pamidronic acid, panitumumab, panobinostat, pantoprazole, pazopanib, pegaspargase, PEG-epoetin beta (methoxy PEG-epoetin beta), pembrolizumab, pemigatinib, pegfilgrastim, peginterferon alfa-2b, pembrolizumab, pemetrexed, pentazocine, pentostatin, peplomycin, Perflubutane, perfosfamide, Pertuzumab, phenoxybenzamine, picibanil, pilocarpine, pirarubicin, pixantrone,
 30 plerixafor, plicamycin, poliglusam, polatuzumab vedotin, polyestradiol phosphate, polyvinylpyrrolidone and sodium hyaluronate, polysaccharide-K, pomalidomide, ponatinib, porfimer sodium, pralatrexate, pralsetinib, prednimustine, prednisone, procarbazine, procodazole, propranolol, quinagolide, quizartinib, rabepazole, racotumomab, radium-223 chloride, radotinib, raloxifene, raltitrexed, ramosetron, ramucirumab, ranimustine, rasburicase, razoxane, refametinib, regorafenib, relugolix, ribociclib,
 35 ripretinib, risedronic acid, rhenium-186 etidronate, rituximab, rivoceranib, rolapitant, romidepsin, romiplostim, romurtide, rucaparib, sacituzumab govitecan, samarium (153Sm) lexidronam, sargramostim, sarilumab, satumomab, secretin, selinexor, selpercatinib, selumetinib, siltuximab, sipuleucel-T, sirolimus, sizofiran, sobuzoxane, sodium glycididazole, sonidegib, sophoridine

hydrochloride, sorafenib, stanozolol, streptozocin, Strontium 89, sunitinib, surufatinib, tagraxofusp, talaporfin, talazoparib, talimogene laherparepvec, tamibarotene, tamoxifen, tapentadol, tasonermin, tazemetostat, teceleukin, technetium (99mTc) nofetumomab merpentan, 99mTc-HYNIC-[Tyr3]-octreotide, tegafur, tegafur + gimeracil + oteracil, temoporfin, temozolomide, temsirolimus, teniposide, testosterone, tetrofosmin, thalidomide, thiotepa, thrombopoietin, thymalfasin, thyrotropin alfa, tioguanine, tirabrutinib, tisagenlecleucel, tislelizumab, tivozanib, tocilizumab, topotecan, toremifene, tositumomab, trabectedin, trametinib, tramadol, trastuzumab, trastuzumab emtansine, treosulfan, tretinoin, trifluridine + tipiracil, trilostane, triptorelin, trametinib, trofosfamide, tryptophan, tucatinib, tucidinostat, recombinant tumor necrosis α -factor of thymosine- α 1, ubenimex, ulipristal, umbralisib, valatinib, valrubicin, vandetanib, vapreotide, vemurafenib, venetoclax, vinblastine, vincristine, vindesine, vinflunine, vinorelbine, vismodegib, vorinostat, vorozole, yttrium-90 glass microspheres, zanubrutinib, zinostatin, zinostatin stimalamer, zoledronic acid, zorubicin.

The term “combination” in the present invention is used as known to persons skilled in the art, it being possible for said combination to be a fixed combination, a non-fixed combination or a kit-of-parts.

A “fixed combination” in the present invention is used as known to persons skilled in the art and is defined as a combination wherein, for example, a first active ingredient, such as one or more compounds of general formula (I) of the present invention, and a further active ingredient are present together in one unit dosage or in one single entity. One example of a “fixed combination” is a pharmaceutical composition wherein a first active ingredient and a further active ingredient are present in admixture for simultaneous administration, such as e.g. in a formulation. Another example of a “fixed combination” is a pharmaceutical combination wherein a first active ingredient and a further active ingredient are present in one unit without being in admixture.

A non-fixed combination or “kit-of-parts” in the present invention is used as known to persons skilled in the art and is defined as a combination wherein a first active ingredient and a further active ingredient are present in more than one unit. One example of a non-fixed combination or kit-of-parts is a combination wherein the first active ingredient and the further active ingredient are present separately. It is possible for the components of the non-fixed combination or kit-of-parts to be administered separately, sequentially, simultaneously, concurrently or chronologically staggered.

In another embodiment the invention relates to a pharmaceutical composition comprising polymorph C of the compound of formula (I) and optionally an amount of other forms of the compound of formula (I) in combination with another anti-cancer agent as listed above.

Pharmaceutical compositions

It is possible for the crystalline form C of the compound of formula (I) according to the present invention to have systemic and/or local activity. For this purpose, it can be administered in a suitable manner, such as, for example, via the oral, parenteral, pulmonary, nasal, sublingual, lingual, buccal, rectal, vaginal, dermal, transdermal, conjunctival, otic route or as an implant or stent.

For these administration routes, it is possible for the crystalline form C of the compound of formula (I) according to the present invention to be administered in suitable administration forms.

For oral administration, it is possible to formulate the crystalline form C of the compound of formula (I) according to the present invention to dosage forms known in the art that deliver the compounds of the invention rapidly and/or in a modified manner, such as, for example, tablets (uncoated or coated tablets, for example with enteric or controlled release coatings that dissolve with a delay or are insoluble), orally-disintegrating tablets, films/wafers, films/lyophilisates, capsules (for example hard or soft gelatine capsules), sugar-coated tablets, granules, pellets, powders, emulsions, suspensions, aerosols or solutions. It is possible to incorporate the compound according to the invention in crystalline and/or amorphous and/or dissolved form into said dosage forms.

Parenteral administration can be effected with avoidance of an absorption step (for example intravenous, intraarterial, intracardial, intraspinal or intralumbal) or with inclusion of absorption (for example intramuscular, subcutaneous, intracutaneous, percutaneous or intraperitoneal). Administration forms which are suitable for parenteral administration are, inter alia, preparations for injection and infusion in the form of solutions, suspensions, emulsions, lyophilisates or sterile powders.

Examples which are suitable for other administration routes are pharmaceutical forms for inhalation [inter alia powder inhalers, nebulizers], nasal drops, nasal solutions, nasal sprays; tablets/films/wafers/capsules for lingual, sublingual or buccal administration; suppositories; eye drops, eye ointments, eye baths, ocular inserts, ear drops, ear sprays, ear powders, ear-rinses, ear tampons; vaginal capsules, aqueous suspensions (lotions, mixturae agitandae), lipophilic suspensions, emulsions, ointments, creams, transdermal therapeutic systems (such as, for example, patches), milk, pastes, foams, dusting powders, implants or stents.

The crystalline form of the compound of formula (I) can be incorporated into the stated administration forms. This can be effected in a manner known per se by mixing with pharmaceutically suitable excipients. Pharmaceutically suitable excipients include, inter alia,

- fillers and carriers (for example cellulose, microcrystalline cellulose (such as, for example, Avicel®), lactose, mannitol, starch, calcium phosphate (such as, for example, Di-Cafos®)),

- ointment bases (for example petroleum jelly, paraffins, triglycerides, waxes, wool wax, wool wax alcohols, lanolin, hydrophilic ointment, polyethylene glycols),
- bases for suppositories (for example polyethylene glycols, cacao butter, hard fat),
- solvents (for example water, ethanol, isopropanol, glycerol, propylene glycol, medium chain-length triglycerides fatty oils, liquid polyethylene glycols, paraffins),
- surfactants, emulsifiers, dispersants or wetters (for example sodium dodecyl sulfate), lecithin, phospholipids, fatty alcohols (such as, for example, Lanette[®]), sorbitan fatty acid esters (such as, for example, Span[®]), polyoxyethylene sorbitan fatty acid esters (such as, for example, Tween[®]), polyoxyethylene fatty acid glycerides (such as, for example, Cremophor[®]), polyoxethylene fatty acid esters, polyoxyethylene fatty alcohol ethers, glycerol fatty acid esters, poloxamers (such as, for example, Pluronic[®]),
- buffers, acids and bases (for example phosphates, carbonates, citric acid, acetic acid, hydrochloric acid, sodium hydroxide solution, ammonium carbonate, trometamol, triethanolamine),
- isotonicity agents (for example glucose, sodium chloride),
- adsorbents (for example highly-disperse silicas),
- viscosity-increasing agents, gel formers, thickeners and/or binders (for example polyvinylpyrrolidone, methylcellulose, hydroxypropylmethylcellulose, hydroxypropylcellulose, carboxymethylcellulose-sodium, starch, carbomers, polyacrylic acids (such as, for example, Carbopol[®]); alginates, gelatine),
- disintegrants (for example modified starch, carboxymethylcellulose-sodium, sodium starch glycolate (such as, for example, Explotab[®]), cross- linked polyvinylpyrrolidone, croscarmellose-sodium (such as, for example, AcDiSol[®])),
- flow regulators, lubricants, glidants and mould release agents (for example magnesium stearate, stearic acid, talc, highly-disperse silicas (such as, for example, Aerosil[®])),
- coating materials (for example sugar, shellac) and film formers for films or diffusion membranes which dissolve rapidly or in a modified manner (for example polyvinylpyrrolidones (such as, for example, Kollidon[®]), polyvinyl alcohol, hydroxypropylmethylcellulose, hydroxypropylcellulose, ethylcellulose, hydroxypropylmethylcellulose phthalate, cellulose acetate, cellulose acetate phthalate, polyacrylates, polymethacrylates such as, for example, Eudragit[®])),
- capsule materials (for example gelatine, hydroxypropylmethylcellulose),
- synthetic polymers (for example polylactides, polyglycolides, polyacrylates, polymethacrylates (such as, for example, Eudragit[®]), polyvinylpyrrolidones (such as, for example, Kollidon[®]),

polyvinyl alcohols, polyvinyl acetates, polyethylene oxides, polyethylene glycols and their copolymers and blockcopolymers),

- plasticizers (for example polyethylene glycols, propylene glycol, glycerol, triacetine, triacetyl citrate, dibutyl phthalate),

5 • penetration enhancers,

- stabilisers (for example antioxidants such as, for example, ascorbic acid, ascorbyl palmitate, sodium ascorbate, butylhydroxyanisole, butylhydroxytoluene, propyl gallate),

- preservatives (for example parabens, sorbic acid, thiomersal, benzalkonium chloride, chlorhexidine acetate, sodium benzoate),

10 • colourants (for example inorganic pigments such as, for example, iron oxides, titanium dioxide),

- flavourings, sweeteners, flavour- and/or odour-masking agents.

The present invention furthermore relates to a pharmaceutical composition comprising at least the crystalline form C of the compound of formula (I) according to the present invention, conventionally
15 together with one or more pharmaceutically suitable excipient(s), and their use according to the present invention.

Furthermore in some embodiments the invention relates to a pharmaceutical composition comprising polymorph C of the compound of formula (I) and optionally further pharmaceutically acceptable excipients.

20 In another embodiment the invention relates to the pharmaceutical composition comprising polymorph C of the compound of the formula (I) mainly and no significant fractions of another form of the compound of formula (I) and optionally further pharmaceutically acceptable excipients

As used herein, “Significant fractions of another form of the compound of formula (I)” means containing less than 15 % of another form or other forms of the compounds of formula (I) vs the
25 complete weight amount of the compound of formula (I) contained in the pharmaceutical composition being 100 weight%, preferably less than 10 % of another form or other form of the compounds of formula (I), more preferably less than 5 % of another form or other form of the compounds of formula (I), most preferably substantially free of another form or other forms of the compound of formula (I). Whereby the term “another form or other forms” as used herein means all possible polymorphic forms
30 of the compound of formula (I) other than polymorph C and “substantially free of another form or other forms of the compound of formula (I)” as used herein means the weight percentage of another form or other forms of the compound of formula (I) is less than 2.5 %, preferably less than 1 % and more preferably less than 0.5 % vs. the whole amount of the compound of formula (I) being 100%.

In yet other embodiments the invention relates to the pharmaceutical composition comprising polymorph C of the compound of formula (I) mainly and less than 15 % of another form or other forms of the compound of formula (I) and optionally further pharmaceutically acceptable excipients.

5 In further embodiments the invention relates to the pharmaceutical composition comprising polymorph C of the compound of the formula (I) wherein the amount of another form or other forms of the compound of formula (I) is less than 10 %.

In further embodiments the invention relates to the pharmaceutical composition comprising polymorph C of the compound of the formula (I), wherein the amount of another form or other forms of the compound of formula (I) is less than 5 %.

10 In another embodiment the invention relates to the pharmaceutical composition comprising polymorph C of the compound of the formula (I), wherein the composition is substantially free of another form or other forms of the compound of formula (I) than polymorph C.

Dosage of the pharmaceutical compositions of the present invention:

15 Based upon laboratory techniques known to evaluate compounds useful for the treatment of disorders, by pharmacological assays for the determination of treatment of the conditions identified above in mammals, and by comparison of these results with the results of known medicaments that are used to treat these conditions, the effective dosage of the compound of this invention can readily be determined for treatment of each desired indication. The amount of the active ingredient to be administered in the treatment of one of these conditions can vary widely according to such considerations as the particular
20 compound and dosage unit employed, the mode of administration, the period of treatment, the age and sex of the patient treated, and the nature and extent of the condition treated.

The total amount of the active ingredient to be administered by injection, including intravenous, intramuscular, subcutaneous and parenteral injections, and use of infusion techniques, rectal dosage, vaginal dosage regimen, topical dosage regimen, transdermal dosage, inhalation dosage or oral dosage
25 will generally range from about 0.01 to 200 mg/kg body weight per day. A unit dosage may contain from about 0.001 g to about 1.500 g of active ingredient, and can be administered one or more times per day or less than once a day. In one aspect the unit dosage contains 10 mg of active ingredient.

Of course the specific initial and continuing dosage regimen for each patient will vary according to the nature and severity of the condition as determined by the attending diagnostician, the activity of the
30 specific compound employed, the age and general condition of the patient, time of administration, route of administration, rate of excretion of the drug, drug combinations, and the like. The desired mode of treatment and number of doses of a compound of the present invention or a pharmaceutically acceptable salt or ester or composition thereof can be ascertained by those skilled in the art using conventional treatment tests.

Solvent ratios, dilution ratios and concentration data of liquid/liquid solutions are based on each case on the volume.

Working examples

5 **General Methods:**

Differential Scanning Calorimetry (DSC) /Thermogravimetry (TG) or Thermogravimetry Analysis (TGA)

a) Preparation of the sample

There was no sample preparation.

10 b) Measurement details

1) Differential scanning calorimetry (DSC) was performed with a Perkin Elmer thermal analysis system Diamond DSC and DSC 8000. The calorimeter was purged with nitrogen gas. 2 - 5 mg of each sample was placed into a perforated aluminum crucible and heated at a rate of 2 or 20 K/min from -0 °C to 160°C. There was no sample preparation.

15 2) Thermogravimetric analysis (TGA) was performed with a Perkin Elmer thermal analysis system TGA7. The instrument was purged with nitrogen gas. Approximately 2 – 5 mg of each sample was placed into an open platinum crucible and heated at a heating rate of 10 K/min from 35°C to 160°C.

XRPD

20 **Method A:**

a) Preparation of the sample

There was no sample preparation.

b) Measurement details

25 X-Ray diffraction patterns were recorded at room temperature using XRD–Transmissions-Diffractometer X'Pert PRO (PANalytical) (radiation Cu K alpha 1, wavelength 1.5406 Å, 40 mA, 40 kV). There was no sample preparation. All X-Ray reflections are quoted as 2θ (theta) values (peak maxima) with a resolution of $\pm 0.2^\circ$.

Method B

30 X-ray powder diffraction (XRPD) data were recorded on a STOE STADI P diffractometer using monochromatized CuK α 1-radiation, a position sensitive detector, at generator settings of 40 kV and 40 mA. The samples were collected in transition mode, being prepared as a thin layer between two foils. The scanning range was between 2° and $40^\circ 2\theta$ (theta) values with a 0.5° step at 15 sec/step.

35 **IR**

a) Preparation of the sample

There is no sample preparation

b) Measurement details

IR spectra were acquired on a IR-Spectrometer Bruker Tensor 37 with ATR-unit. Each spectrum represents 64 coadded scans with a resolution of 2 cm^{-1} in the following measuring range of $550\text{--}4000\text{ cm}^{-1}$.

5

Raman

a) Preparation of the sample

There was no sample preparation

b) Measurement details

10 Raman spectra were recorded at room temperature using FT-Raman-spectrometers (model RFS 100 and MultiRam) from Bruker at 25°C using a 1064 nm NdYAG Laser. Resolution was 2 cm^{-1} . Measurements were performed in glass vials or aluminium discs. Each spectrum represents 64 coadded scans with a resolution of 2 cm^{-1} in the following measuring range of $100\text{--}3500\text{ cm}^{-1}$.

15 **LCMS (method 1): HSST3**

Instrument: Waters ACQUITY SQD UPLC system; column: Waters Acquity UPLC HSS T3 $1.8\text{ }\mu\text{m}$ $50\text{ x }1\text{ mm}$; eluent A: 1 L water + 0.25 ml 99% formic acid, eluent B: 1 L acetonitrile + 0.25 mL 99% formic acid; gradient: $0.0\text{ min }90\% \text{ A} \rightarrow 1.2\text{ min }5\% \text{ A} \rightarrow 2.0\text{ min }5\% \text{ A}$; flow rate: 0.40 mL/min ; UV detection: $208\text{--}400\text{ nm}$.

20

GCMS (method 2): DSQ-II

Instrument: Thermo Scientific DSQII, Thermo Scientific Trace GC Ultra system; column: Restek RTX-35MS, $15\text{ m x }200\text{ }\mu\text{m x }0.33\text{ }\mu\text{m}$; constant helium flow: 1.20 mL/min ; oven: 60°C ; inlet: 220°C ; gradient: 60°C , $30^{\circ}\text{C/min} \rightarrow 300^{\circ}\text{C}$ (hold time 3.33 min).

25

Chiral HPLC (method 3):

System: High performance liquid chromatograph equipped with gradient pumps, UV detector & attached with data recorder and integrator software; column: Chiralpak IA ($250\text{ x }4.6\text{ mm}$, $5\text{ }\mu\text{m}$); flow: 1 mL/min ; column temperature: 40°C ; injection volume $10\text{ }\mu\text{L}$, detection 292 nm , run time: 15 min ;
30 mobile phase: n-heptane / 2-propanol $90/10\text{ (v/v)}$.

Methods for establishing the amount of amorphous form

in a crystallisate of the compound of formula (I) can be found in:

35 Dedroog, Sien, et al. "Solid-state analysis of amorphous solid dispersions: Why DSC and XRPD may not be regarded as stand-alone techniques." Journal of Pharmaceutical and Biomedical Analysis 178 (2020): 112937 and

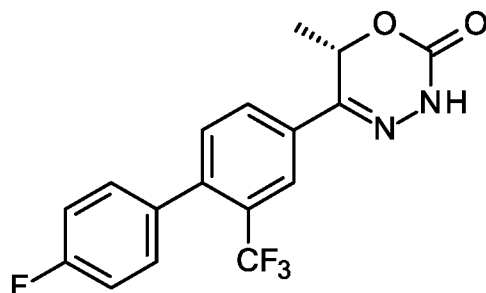
Ueda, Hiroshi, et al. "Raman mapping for kinetic analysis of crystallization of amorphous drug based on distributional images." International journal of pharmaceutics 462.1-2 (2014): 115-122.

Purity

For defining the purity of a polymorphic form the person with ordinary skill knows how to do it, e.g. by establishing for known polymorphic forms the calibration curves using XRPD in order to define weight % amounts of these forms comparing with an XRPD, Raman- and/or IR-spectrum of a certain

5 crystallisate of the compound of formula (I) as obtained e.g. by the synthesis.

Example 1: Manufacture of polymorphic forms of (6S)-5-[4'-Fluoro-2-(trifluoromethyl)biphenyl-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one – the compound of formula (I) - in large scale



5

(I)

The compound of formula (I) can be prepared according to the procedures disclosed in WO2019/025562.

An alternative process can be performed according to the following examples 1.1 – 1.5:

Example 1.1 - 4-Bromo-4'-fluoro-2-(trifluoromethyl)[biphenyl]

To 166,3 kg toluene and 96,0 kg water 24,0 kg (68,4 mol) commercially available 4-bromo-1-iodo-2-(trifluoromethyl)benzene, 12,5 kg (89,3 mol) (4-fluorophenyl)boronic acid and 21,7 kg (204,7 mol) sodium carbonate were added. To the mixture was added 250 g (0,34 mol) Pd(dppf)Cl₂ and the resulting biphasic solution was heated to 50° - 60°C for 6 h. The mixture was cooled down to 20°C and the phases were separated. The aqueous phase was extracted with 41,6 kg toluene and the toluene phases were combined. The organic phase was filtered through silica gel (12 Kg) to remove Pd-residues. Subsequently, the organic solvent was removed in vacuo to give crude product, which was distilled (1 mbar, 120°C) to give 16,6 kg 4-bromo-4'-fluoro-2-(trifluoromethyl)[biphenyl] as a colorless liquid in 76 % yield.

¹H NMR (600 MHz, DMSO-d₆) δ ppm: 7,29 (m, 2 H), 7,36 (t, J=7,63 Hz, 3 H), 7,94 (dd, J₁=8,22 Hz, J₂=1,96 Hz, 1 H), 8,00 (d, J=1,96 Hz, 1 H).

GCMS (method 2): Rt = 4,69 min; MS m/z = 320, 318 (M-H)⁺, 219, 170, 110.

Example 1.2 - (2S)-1-[4'-Fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-(tetrahydro-2H-pyran-2-yloxy)propan-1-one

To 1,80 kg (5,64 mol) 4-bromo-4'-fluoro-2-(trifluoromethyl)[biphenyl] 1,60 kg THF were added. At 20°C, 3,30 kg (6,77 mol) Isopropylmagnesium chloride 2M in THF were added to the above prepared solution over 45 min. During preparation of the Grignard solution, the reaction mixture gets heated to 28°C and the mixture is stirred at 28°C for 5 h. The mixture is cooled to 0 - 4°C.

A solution of 1,53 kg (6,28 mol) (2S)-1-(morpholin-4-yl)-2-(tetrahydro-2H-pyran-2-yloxy)propan-1-one prepared according to J. Pesti et al., Org. Process Res. Dev. 2009, 13, 716 - 728; (using the alternative

enantiomer as starting material) in 3,20 kg THF is added to the above prepared Grignard reagent at 0 - 4°C within 30 min. The mixture is heated to 20°C and is stirred for 30 min at 20°C.

A citric acid solution in water (prepared from 2,70 kg citric acid and 10,10 kg water) is added to the mixture at 20°C. The addition takes about 60 min.

- 5 11,34 kg Ethyl acetate are added to the quenched mixture and the two-phasic mixture is stirred for 10 min at 20 °C. The phases are separated and the lower aqueous phase is discarded.

To the upper organic phase (approx. 24 L) is added 6,50 kg saturated NaCl solution in water and the mixture is stirred for 10 min at 20°C. The phases are separated and the lower aqueous phase is discarded.

- 10 The organic solvent of the upper organic phase (approx. 22,5 L) is distilled off (approx. 17,5 L solvent is distilled off) at 50°C and 80 mbar to give an oil. 8,10 kg ethyl acetate are added to the oil and the solvent is removed at 50°C and 80 mbar (approx. 9 L solvent is distilled off). To the residue is added 9,10 kg ethyl acetate.

- The prepared solution of (2R)-1-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-(tetrahydro-2H-pyran-2-yloxy)propan-1-one in Ethyl acetate (approx. 12 kg solution) is used in the next step (synthesis of (2R)-1-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-hydroxypropan-1-one).

- 1H NMR (600 MHz, DMSO-d₆) δ ppm: 0,99 (m, 1 H), 1,25 (m, 1 H), 1,38 (d, J=6,65 Hz, 3 H), 1,44 (d, J=6,85 Hz, 3 H), 1,48 (m, 5 H), 1,69 (m, 5 H), 3,47 (m, 1 H), 3,55 (d, J=4,89 Hz, 1 H), 3,63 (td, J₁=7,43 Hz, J₂=7,43 Hz, J₃=3,52 Hz, 1 H), 3,81 (m, 1 H), 4,67 (t, J=3,33 Hz, 1 H), 4,82 (dd, J₁=5,09 Hz, J₂=2,15 Hz, 1 H), 5,09 (q, J=6,65 Hz, 1 H), 5,24 (q, J=7,04 Hz, 1 H), 7,32 (td, J₁=8,90 Hz, J₂=0,98 Hz, 4 H), 7,42 (m, 4 H), 7,60 (dd, J₁=7,92 Hz, J₂=4,79 Hz, 2 H), 8,34 (m, 3 H), 8,49 (s, 1 H).

GCMS (method 2): Rt = 3,67 min; MS m/z = 240, 219, 201, 170.

Example 1.3 - (2S)-1-[4'-Fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-hydroxypropan-1-one

- 25 To 12 kg solution of (2S)-1-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-(tetrahydro-2H-pyran-2-yloxy)propan-1-one in ethyl acetate (see example 2) is added 1,09 kg (11,3 mol) of methanesulfonic acid at 20°C. The mixture is stirred for 2 h at 20°C.

8 kg water are added to the dark mixture at 20°C and the mixture is stirred for 10 min.

The phases are separated and the aqueous phase (approx. 9 kg) is extracted with 3 kg ethyl acetate.

- 30 The Ethyl acetate phases from both extractions are combined and 6 kg saturated NaCl solution in water is added. The mixture is stirred for 10 min. The phases are separated and the lower aqueous phase is discarded.

The upper organic phase (approx. 16 L) is distilled off at 50°C and 80 mbar to give an oil. 5 kg Ethyl acetate is added to the oil and the solvent is distilled off at 50°C and 80 mbar to give an oil.

- 35 The resulting oil is purified by flash chromatography (SiO₂) with heptane/ethyl acetate (2:1) or can be alternatively distilled (< 0,1 mbar, 100°C) to give the purified (2S)-1-[4'-fluoro-2-(trifluoromethyl)-[biphenyl]-4-yl]-2-hydroxypropan-1-one (approx. 1,2 kg) as a slightly yellow oil in 68% yield over 2 steps.

¹H NMR (600 MHz, DMSO-d₆) δ ppm: 1,34 (d, J=6,85 Hz, 3 H), 5,07 (quin, J=6,65 Hz, 1 H), 5,61 (d, J=6,46 Hz, 1 H), 7,32 (t, J=8,80 Hz, 2 H), 7,41 (dd, J₁=8,51 Hz, J₂=5,58 Hz, 2 H), 7,58 (d, J=8,02 Hz, 1 H), 8,32 (d, J=8,02 Hz, 1 H), 8,37 (s, 1 H).

The two steps described here (synthesis of (2S)-1-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-(tetrahydro-2H-pyran-2-yloxy)propan-1-one and synthesis of (2S)-1-[4'-fluoro-2-(trifluoromethyl)-[biphenyl]-4-yl]-2-hydroxypropan-1-one) were performed several times and batches were combined to get 3,05 kg of (2S)-1-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-hydroxypropan-1-one to perform the next step (Example 1.4) in reasonable batch size.

Example 1.4 - Methyl (2Z)-2-{(2S)-1-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-hydroxypropylidene}hydrazinecarboxylate

To 3,05 kg (9,76 mol) (2S)-1-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-hydroxypropan-1-one is added 21,2 kg ethanol. 0,88 kg (9,76 mol) methyl hydrazine carboxylate as well as 0,1 L of HCl 0,1M in water (0,01 mol) are added at 20 °C. The mixture is heated to reflux for 18 h.

Approx. 20 L of solvent are distilled off at 90°C and 7,4 kg diisopropyl ether is added.

Approx. 9 L of solvent are distilled off at 80 - 90°C and 7,4 kg diisopropyl ether is added.

Approx. 12 L of solvent are distilled off at 80 - 90°C and 7,4 kg diisopropyl ether is added.

The mixture is cooled to 2°C over 60 min and is stirred for approx. 8 h at 2 °C.

The precipitated product is filtered and washed twice with each time 2 kg cold diisopropyl ether.

The wet product is dried at 50°C in-vacuo to give 2,01 kg of methyl (2Z)-2-{(2S)-1-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-hydroxypropylidene}hydrazinecarboxylate as a white solid in 54 % yield.

¹H NMR (400 MHz, DMSO-d₆) δ ppm: 1,38 (d, J=6,72 Hz, 3 H), 3,72 (s, 3 H), 5,27 (dd, J₁=6,79 Hz, J₂=3,36 Hz, 1 H), 6,38 (d, J=3,06 Hz, 1 H), 7,36 (m, 5 H), 8,00 (d, J=8,34 Hz, 1 H), 8,12 (s, 1 H), 11,06 (s, 1 H).

LCMS (method 1): Rt = 1,04 min; MS (ESIpos): m/z = 385 (M+H)⁺

Example 1.5 - (6S)-5-[4'-Fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one (compound of formula (I))

To 15,8 kg ethanol is added 2,00 kg (5,20 mol) methyl (2Z)-2-[(2S)-1-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-2-hydroxypropylidene}hydrazinecarboxylate at 20°C.

5 464 g sodium hydroxide solution (45% in water) is added and the mixture is stirred at 20°C for 1 h. Subsequently, 312 g acetic acid is added and the mixture is stirred at 20°C for 30 min.

After filtration (final processing), 21,0 kg purified water is added to the mixture at 20°C. A suspension of seed crystals*) (polymorph C) in ethanol/water (1:1) was added. The mixture is stirred at 20°C for 8 h. The crystallized product is filtered, washed twice each time with 2 L water/ethanol (1:1) and dried at

10 50°C in-vacuo to give 1,66 kg (6S)-5-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one as a white solid in 91% yield.

*) seed crystals could be produced by the following method:

0,5 g of (6S)-5-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-
15 2-one (obtained as polymorph A and B in analogy to e.g. published methods) is added to 10 mL of a 1:1 mixture of water/ethanol (approx. 5 wweight %). A suspension of (6S)-5-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one in ethanol/water (1:1) is formed. After stirring the suspension for 16 h at 30°C, the suspension is filtered. The solid is dried to obtain (6S)-5-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-
20 2-one in polymorph C. The first seed crystals were obtained following the route described in example 1.8

¹H NMR (500 MHz, DMSO-d₆) δ ppm: 1,49 (d, J=6,94 Hz, 3 H), 5,96 (q, J=6,91 Hz, 1 H), 7,31 (t, J=7,96 Hz, 2 H), 7,40 (t, J=6,48 Hz, 2 H), 7,53 (d, J=8,04 Hz, 1 H), 8,06 (dd, J₁=8,12 Hz, J₂=1,50 Hz, 1
25 H), 8,17 (s, 1 H), 11,32 (s, 1 H).

LCMS (method 1): Rt = 1,02 min; MS (ESI^{neg}): m/z = 351 (M-H)⁻

Chiral HPLC (method 3): Rt (R-enantiomer) = 10,5 min; Rt (S-enantiomer) = 11,5 min.

ee (S-enantiomer) > 99,5%.

Polymorph C was obtained in example 1.5 as shown in the XRPD diagram of FIG. 1 using Method B.

30 The reflections are listed below:

Reflections (Peak maxima) [°2Theta]
11,9
15,1
15,2
17,3
18,7
18,8
19,0

Reflections (Peak maxima) [°2Theta]
21,1
22,7
23,7
24,0
25,3
26,8
27,1
28,0
28,0
28,5
29,8
30,4
30,6
31,7
33,0
34,2
34,9
35,1
35,8
36,2
36,6
37,0
37,3
37,5
37,7
38,5
39,2

Optionally a micronization step can be performed.

In analogy to Example 1.5, five batches**) were prepared and subsequently all batches were combined and micronized twice in a row to give 5,60 kg of micronized material. Here, details for micronization are given:

5

Five batches of (6S)-5-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one were prepared according to Example 1.5 and were combined. The combined batches were micronized twice in a row using an air jet mill.

a) Used Device:

Used device: Mill	200 mm spiral jet mill (Bayer design)
Dosing device (Type)	vibrating chute
Grinding chamber lining (material)	PTFE
Injector motive nozzle (diameter)	2,9 mm
Grinding nozzle (diameter)	2,2 mm 32°
Collecting nozzle (diameter)	8 mm PTFE

Outlet opening (diameter)	28,3 mm PTFE
---------------------------	--------------

b) Grinding Parameters

Grinding Parameter	Actual value
Injector air pressure [bar]	4,3
Grinding air pressure [bar]	6
Product throughput [g/min]	100
Total grinding time [min]	68

5

c) The micronized product obtained has the following properties:

Particle Size distribution (X10/X50/X90): 1,2/4/10 μm .

The instrumental set-up for particle size analysis:

10 Laser diffraction pattern analyzer (Sympatec HELOS, H1970 & RODOS, R3:0.5/0.9....175 μm),
100 mm focal length,

Dry dispersion (RODOS) at 4 bar,

Mathematical model (LD 5.9.0.0) – Sympatec Code, basis Fraunhofer Diffraction

15 **) A probe of the product of one of these five batches was used in example 4 and 5 as probe 2. The
XRPD spectrum is shown in Figure. 2 which is obtained using Method B.

Example 1.6 – Preparation of polymorph A

20 If the seed crystals mentioned in example 1.5 were dissolved completely or not added at all, polymorph
A was spontaneously obtained by following the same procedure as described above under 1.5.

To 15,8 kg ethanol is added 2,00 kg (5,20 mol) methyl (2Z)-2-[(2S)-1-[4'-fluoro-2-(trifluoromethyl)
[biphenyl]-4-yl]-2-hydroxypropylidene}hydrazinecarboxylate at 20°C.

464 g sodium hydroxide solution (45 % in water) is added and the mixture is stirred at 20°C for
25 minimum 4 h. Subsequently, 312 g acetic acid is added and the mixture is stirred at 20°C for 30 min.

After filtration (final processing), 21,0 kg purified water is added over 3 h to the mixture at 20°C. A
suspension of seed crystals*) (polymorph C) in ethanol/water (1:1) was added during addition of the
water. The mixture is stirred at 20°C for 8 h. A further suspension of seed crystals*) (polymorph C) in
ethanol/water (1:1) was added. The mixture is stirred at 20°C for 8 h. The mixture was heated to 60°C
30 and then cooled to 50°C. A further suspension of seed crystals*) (polymorph C) in ethanol/water (1:1)
was added. The mixture was cooled to 20°C using a linear 2 h ramp. The mixture was stirred at 20°C for
8 h. The crystallized product is filtered, washed twice each time with 2 L water/ethanol (1:1) and dried

at 50°C in-vacuo to give 1,24 kg (6S)-5-[4'-fluoro-2-(trifluoromethyl)][biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one, polymorph A, as a white solid in 67% yield.

The respective XRPD diagram is illustrated by Figure. 3 which was obtained using Method B.

The product as obtained was used in examples 4 and 5 as probe 1.

5

Example 1.7 - Alternatively to example 1.5 the following procedure could also be followed, surprisingly directly leading to polymorph B:

Crude methyl (2Z)-2-[(2S)-1-[4'-fluoro-2-(trifluoromethyl) [biphenyl]-4-yl]-2-hydroxypropylidene}hydrazinecarboxylate (approx. 13,54 g in 100 mL methanol) was stirred at room temperature and 26,1 mL of sodium methylate (5,4 M in methanol) were added at room temperature. The mixture was stirred at room temperature overnight. 8,46 g of acetic acid were added and the mixture was stirred for 10 min at room temperature. The mixture was concentrated in vacuo. Saturated aqueous sodium chloride solution was added and the mixture was extracted with ethyl acetate. The organic phase was dried and concentrated in vacuo. 13,00 g of a crude oil were obtained. The crude oil was purified via column chromatography twice (SiO₂, hexane/ethyl acetate 100:0 to 70:30). The fractions containing the product were concentrated in vacuo giving 7,8 g of product, which were suspended in 140 mL of ethanol/water 1:1 and stirred for 30 min at room temperature. The obtained solid was filtered off and suspended again in 140 mL of ethanol/water 1:1 and stirred for 30 min at room temperature. The obtained solid was filtered off and dried overnight at 50°C. 4,20 g of (6S)-5-[4'-fluoro-2-(trifluoromethyl)][biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one were obtained. As a result polymorph B was obtained which is illustrated by the XRPD of FIG. 4 (obtained by using Method A), the IR-Spectrum of FIG. 11 and the Raman spectrum of Figure. 14

Example 1.8 First preparation of polymorph C

1) In a vessel was charged (6S)-5-[4-chloro-3-(trifluoromethyl)phenyl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one (7.65 g, 25.10 mmol) obtained following the route described under "Intermediate 74" as starting material for example 135 of WO2019/025562, 4-fluorophenylboronic acid (5.27 mg, 37.64 mmol), 2-(dicyclohexylphosphino)-2',4',6'-triisopropylbiphenyl (XPhos, 718 mg, 1.51 mmol) and K₂CO₃ (7.18 g, 50.19 mmol) and chloro(2-dicyclohexylphosphino-2',4',6'-triisopropyl-1,1'-biphenyl)[2-(2'-amino-1,1'-biphenyl)]palladium(II), X-Phos aminobiphenyl palladium chloride precatalyst (XPhos-Pd-G2, 1.18 g, 0.75 mmol) in 1,4-dioxane (115 mL) and water (38.4 mL). The resultant mixture was degassed via nitrogen-filled balloon for 5 mins, with subsequent heating at 80°C for 2 hours. After this time, the mixture was diluted with ethyl acetate (50 mL) and washed with saturated aqueous NaCl solution (3 x 20 mL), dried (Na₂SO₄), filtered and concentrated at reduced pressure. The residue was purified via Biotage Isolera chromatography (using a gradient of eluents; 1:0 to 1:1 heptane:ethyl acetate). The desired fractions were combined, concentrated in vacuo and triturated with tert-butylmethyl ether/heptane (1:1) with the insoluble material isolated by suction filtration and dried in vacuo to give a grey powder (6.45 g, 95.88 %ee). This material was suspended in 40%Ethanol/Water

and warmed to facilitate dissolution. Once the majority of the material was dissolved, the solution was filtered through a cotton plug and allowed to cool to room temperature and stand at room temperature for 60 h. After this time, the crystallized material was isolated by suction filtration and dried in vacuo to afford the product as a colourless crystalline solid (4.48 g, 89.1 % ee). This material was suspended in 40% ethanol/water and warmed to facilitate dissolution, with the solution was filtered through a cotton plug and allowed to cool to room temperature and stand at room temperature for 16 h, with the crop of crystalline material isolated to afford (6S)-5-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one in 39% yield (3.46 g, 93.78 % ee). This process lead to Polymorph B. The XRPD of Polymorph B as obtained is illustrated in Figure. 5 (obtained by using Method A). %ee means % enantiomeric excess.

2) In a flask (6S)-5-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one (2.00 g, (93.78 % ee) of the product as obtained under 1) of example 1.8, which was stored at room temperature for about 7 month, was suspended in 20 mL of water and 20 mL of ethanol and stirred at room temperature for 30 min. The solid was collected by filtration and the collected solids were again suspended in 20 mL of water and 20 mL of ethanol and stirred at room temperature for 30 min. The remaining crystalline solid was collected by filtration again, dried in a vacuum oven at 50°C overnight to yield 1.62 g of the title compound (6S)-5-[4'-fluoro-2-(trifluoromethyl)[biphenyl]-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one with 99.7 % ee (99% purity by LCMS and ¹H-NMR). Surprisingly the obtained product had another polymorph, which was polymorph C.

The XRPD is shown in Figure. 6 (obtained by using Method A). Its reflections are shown below:

Reflections (Peak maxima) [°2Theta]
8.3
11.8
11.9
15.1
15.1
17.3
18.8
18.9
20.9
21.1
22.5
22.6
23.6
26.8
28.0
28.5
29.6
29.8
30.4
30.5
31.5
31.6

Reflections (Peak maxima) [$^{\circ}2\theta$]
33.0
34.9
35.1
35.8
36.2
36.6
36.9
37.3
37.6

Example 2 Crystallization experiments

2.1 Preparation of Polymorph A:

400 mg of the compound of formula (I) as obtained in example 1.7 was dissolved in 40 mL of the below mentioned solvents at room temperature followed by heating under reflux. The resulting solutions were quartered and stored

- at ambient conditions
- in a refrigerator
- in a freezer

until evaporation was completed whereas the last quarter was

- precipitated with water and evaporated under ambient conditions.

For acetone and acetonitrile after one day the precipitate was filtered and dried at room temperature whereas the precipitate from ethanol could not be filtered and hence the suspension was allowed to dry at room temperature.

The respective XRPD diagram is shown in Figure. 7 (obtained by using Method A), the IR- und Raman spectrum is shown in Figure. 10 and Figure. 13 respectively.

Solvent	Conditions	Resulting Polymorph
Acetone	Evaporation at ambient conditions	A
Acetone	Evaporation in a refrigerator	A *)
Acetone + Water	Evaporation at ambient conditions	A
Acetonitrile	Evaporation at ambient conditions	A
Acetonitrile	Evaporation in a refrigerator	A
Acetonitrile + Water	Evaporation at ambient conditions	A
Ethanol	Evaporation at ambient conditions	A
Ethanol	Evaporation in a refrigerator	A
Ethanol	Evaporation in a freezer	A

*) probe used for obtaining the XRPD diagram of Figure 7 and the IR- and Raman spectra of Figures 10 and 13.

2.2 Preparation of Polymorph B:

400 mg of the compound of formula (I) as obtained in example 1.7 was dissolved in 40 mL of ethanol/water at room temperature followed by heating under reflux. The resulting solution was quartered and one quarter was stored at ambient conditions until evaporation was completed

- 5 For the condition mentioned below Polymorph B was obtained.

The respective XRPD diagram is shown in FIG. 8 (obtained by using Method A).

Solvent	Conditions	Resulting Polymorph
Ethanol + Water	Evaporation at ambient conditions	Mod. B *)

*) probe used for obtaining the XRPD diagram of FIG 8.

- 10 The IR- and Raman spectra of Polymorph B shown in Figure. 11 and Figure. 14 were obtained from a sample of example 1.7.

2.3 Preparation of Polymorph C

- 15 In a slurry experiment 107 mg of the compound of formula (I) as obtained in example 1.7 was suspended in 0,5 mL of solvent, seed crystals of example 1.8 2) were added to the resulting suspension and it was shaken for a week at 25°C in a Themomix. After half of the time again 0.5 mL of solvent were added and shaken for a week at 25°C in a Themomix. The mixture was filtered and dried under room conditions.

Solvent	Conditions	Resulting Polymorph
n-Heptan	Slurry experiment	Mod. C
Ethanol/water (1:1)	Slurry experiment	Mod. C *)

- 20 *) probe used for obtaining the XRPD diagram of Figure 9 (obtained by using Method A), the IR- und Raman-spectra as shown in Figure 12 and Figure15 respectively.

Example 3: Physical characterization of polymorphic forms of (6S)-5-[4'-Fluoro-2-(trifluoromethyl)biphenyl-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one, compound of formula (I) by different methods

3.1 XRPD – Reflections and related figures

They are obtained following the method as described under General Methods above as Method A:

Reflections (Peak maxima) [$^{\circ}$ 2 Theta]		
Polymorph A Figure 7	Polymorph B Figure 8	Polymorph C Figure 9
10.2	9.1	11.8
11.8	10.9	11.9
12.3	11.8	15.1
12.8	12.4	17.2
13.2	12.7	18.8
13.5	12.8	18.9
13.9	14.4	21.1
14.3	15.1	22.6
14.4	15.6	22.6
15.2	15.8	26.8
15.4	16.0	27.9
15.9	16.7	28.5
16.3	16.9	29.6
16.7	18.3	29.8
17.0	18.9	30.4
17.4	19.4	31.6
17.8	20.5	33.0
18.2	20.8	
19.0	21.5	
19.3	21.9	
20.5	22.2	
20.7	23.3	
21.0	23.4	
21.5	23.7	
22.0	24.2	
22.2	24.6	
23.2	25.8	
23.9	26.1	
25.6	26.8	
26.0	27.2	

Reflections (Peak maxima) [$^{\circ}$ 2 Theta]		
Polymorph A Figure 7	Polymorph B Figure 8	Polymorph C Figure 9
26.2	27.5	
26.8	28.3	
27.0	29.1	
27.4	30.4	
28.6	33.2	
29.1		
30.3		
35.1		
35.7		
36.7		

3.2 IR bands obtained following the method as described under General Methods above

IR Bands [Peak maxima in cm^{-1}]		
Polymorph A Figure 10	Polymorph B Figure 11	Polymorph C Figure 12
3261	3260	3218
3170	3164	3148
3077	3078	3070
2985	2984	3009
2962	2963	2913
2908	2894	1730
1732	1732	1617
1698	1697	1607
1628	1626	1595
1606	1607	1557
1562	1562	1521
1521	1521	1495
1493	1492	1456
1469	1468	1422
1449	1449	1393
1431	1431	1371
1383	1400	1330
1377	1384	1285

IR Bands [Peak maxima in cm ⁻¹]		
Polymorph A Figure 10	Polymorph B Figure 11	Polymorph C Figure 12
1340	1312	1249
1312	1274	1223
1275	1236	1175
1231	1176	1164
1175	1159	1123
1156	1128	1099
1123	1096	1071
1095	1059	1049
1063	1023	1022
1024	1008	1008
1008	968	978
967	944	961
908	920	921
848	907	907
834	848	862
829	833	837
812	820	814
783	813	775
763	783	765
738	764	753
717	738	733
666	724	725
656	683	678
636	661	665
609	656	659
599	636	633
591	621	593
570	613	581
556	600	570
	591	556
	570	
	557	

3.3 Raman bands obtained following the method as described under General Methods above

Raman Bands [Peak maxima in cm ⁻¹]		
Polymorph Figure 13	Polymorph Figure 14	Polymorph Figure 15
3079	3081	3076
2935	2942	3007
1693	1746	2952
1612	1696	2884
1495	1632	1708
1463	1610	1617
1448	1495	1606
1433	1464	1522
1340	1448	1469
1316	1432	1424
1300	1339	1406
1286	1315	1372
1252	1300	1328
1180	1288	1298
1157	1271	1272
1107	1252	1224
1070	1180	1175
1009	1159	1164
955	1108	1130
849	1070	1095
815	1009	1072
784	843	1054
764	815	1019
735	784	1009
689	735	982
657	685	963
637	662	922
592	637	862
503	611	841
419	591	812
390	417	766

Raman Bands [Peak maxima in cm ⁻¹]		
Polymorph Figure 13	Polymorph Figure 14	Polymorph Figure 15
348	386	733
300	343	680
271	270	665
189	189	637
139	143	593
		580
		569
		546
		487
		440
		418
		388
		340
		316
		283
		250
		165
		141
		120
		92

3.4 DSC- / TGA-Thermograms

For the diagrams shown in the respective figures Figure 16, 17, 18 the following devices and conditions were used, generally following the method as described under General Methods above:

Figure	Mod	Device of Perkin Elmer	Heating for DSC // TGA	Heating rate for DSC/TGA	Sample Weight	Sample
FIG. 16	C	PE-DSC- Diamond 2	-10°C- 160°C // 35°C-160°C	20 K/min // 10 K/min	3,839 mg	Example 2.3)
FIG. 17	B	PE-DSC- Diamond 2	-10°C- 160°C // 35°C-160°C	20 K/min // 10 K/min	3,076 mg	Example 1.7
FIG. 18	A	DSC 8000	-10°C- 160°C // 35°C-160°C	20 K/min // 10 K/min	5,767 mg	Example 2.1

5

For the TGA thermograms the method described under General Method is used for all probes.

Example 4: Powder properties of polymorphic forms of (6S)-5-[4'-Fluoro-2-(trifluoromethyl)biphenyl-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one, [compound of formula (I) in a shear test

10

The device used is the Schulze ring shear tester RST-XS.s for which a general technical product information is available on <http://www.dietmar-schulze.de>. We were using the shear cell XS-SV3. A statement referring to the testing procedure from the technical product information for RST-XS.s reads as follows:

15

“Testing procedure: The powder sample is contained in an annular shear cell “(Figure 19B).

20

“A vertical load [N] is applied through a thin loading rod on the annular lid. To shear the sample, the shear cell rotates relative to the lid (direction ω), and the torque necessary for shearing is determined from forces and F1 and F2 acting in a tie rod and a push rod. Following a well-defined procedure, which is executed computer-controlled, the flow properties are measured. All forces acting are transferred directly on the annular lid through thin rods. This ensures the accurate measurement of normal and shear forces without any friction forces having an influence on the test results.”

25

For measuring flow properties of a wide range of bulk solids, the Schulze ring shear tester has proven its suitability in industrial practice. This device measurement is described in detail in: Schulze, D. (2008). Powders and bulk solids. Behaviour, Characterization, Storage and Flow. Springer Berlin Heidelberg

New York ISBN 978-3-540-73767, chapter 4.1.2, p. 84ff and comprises a shear cell having a volume of 3,5 ml, where the bulk solid is filled in, a lid closing the shear cell, a motor and guiding rolls.

Figure 19A shows the Schulze ring shear tester as described in the book cited above.

Description of the numbers in Figure 19A:

5

<i>1</i>	<i>Bottom ring</i>
<i>2</i>	<i>Lid of shear cell</i>
<i>3</i>	<i>Bulk solid</i>
<i>4</i>	<i>Tension rod</i>
<i>5</i>	<i>Crossbeam</i>
<i>6</i>	<i>Guide roll</i>

Details of the shear cell as shown in Figure 19B:

Typ	XS-SV3 (pyramides at bottom and lid)
material	AlMgCuPb
Cell:	
r_{ISZ} (fillet of the internal volume)	12 mm = 1,2 cm
r_{aSZ} (outer radius of the internal volume)	24 mm = 2,4 cm
d_{ISZ} (inner diameter of the internal volume)	24 mm = 2,4 cm
d_{aSZ} (external diameter of the internal volume)	48 mm = 4,8 cm
h_{SZ} (nominal height of internal volume after filling)	3 mm = 0,3 cm
A_{SZ} (cross section area of sample room)	13,57 cm ²
V_{SZ} (internal volume, pyramids at bottom and lid not taken into account ; $V_{SZ}=H_{SZ} \times A_{SZ}$)	4,072 cm ³
V_{Mt} (Pyramides at bottom and lid)	0,415 cm ³
h_{Mt} (effective height of pyramids at the lid)	0,33 mm = 0,033 cm
Lid:	
r_{ID} (inner radius of the annular lid)	13 mm = 1,3 cm
r_{aD} (external radius of the annular lid)	23 mm = 2,3 cm
d_{ID} (inner diameter of the annular lid)	26 mm = 2,6 cm
d_{aD} (external diameter of the annular lid)	46 mm = 4,6 cm
A_D (area of the annular lid)	11,31 cm ²

Preparation:

- 10 In order to measure the flow properties, the bottom ring of the shear tester is filled with the bulk solid as obtained from example 1.6 (probe 1) or example 1.5 (no micronization, probe 2) to be characterized.

The shear cell was fully filled with a sample of powder of the compound of formula (I) thereby preventing condensing the powder. Both samples, sample 1 and sample 2, were classified as non-hygroscopic applying the Pharmacopeia rules.

After carefully leveling the bulk solid's surface in the ring, the lid and crossbar were put onto the bottom ring. A hanger was connected to the middle of the crossbeam. By automatically putting weights onto the hanger, the bulk solids sample was subjected to a normal load N of 1,5 kPa which induces a normal stress σ in the sample. The force F_A , which was also applied to the middle of the crossbeam, compensates the weight of the crossbeam itself, as well as the weight of the lid and the hanger. At the ends of the cross beam, tension rods are positioned whose other ends are connected to load cells.

Test:

During the shear test, the bottom ring slowly rotated in the direction of the arrow with the low rotational speed ω of 2 rpm maximum. Rotation of the lid was prevented by the tension rods; the tensile forces F_1 and F_2 necessary to achieve this are measured by the load cells. From the normal and shear forces respectively stresses, the so-called yield locus was determined, which describes the flow behavior of a bulk solid. Major parameters of influence on flowability are stress state, particle size distribution (see its determination in Example 5), temperature (24°C), humidity (low at 30 %) and storage time (no storage time).

Results

The experimental data obtained were analyzed following the method described in Schulze, D. (2008). Powders and bulk solids. Behaviour, Characterization, Storage and Flow. Springer Berlin Heidelberg New York ISBN 978-3-540-73767 in order to obtain the graph illustrated by Figure 20 Probe 1 is a sample of polymorph A and Probe 2 is a sample of polymorph C. Figure 21 provides the flow factor of both samples as calculated on basis of the ring shear experiment. X-axis σ [kPa] stands for the normal stress in the sample and the y-axis τ [kPa] stands for shear stress. The dark blue squares show the pre-shear points and the red triangles show the shear points of the shear experiment of Probe 2. The red line is the yield locus of Probe 2. Analog to this the green squares are the pre-shear points and the light blue squares are the shear points of the shear experiment of Probe 1. The green line is the yield locus of Probe 1. The flow factor ff_c can be derived from Figure 20 as follows: Two Mohr circles can be constructed: the larger Mohr circle touches the yield locus and the pre-shear point is a point of this circle (center point of the circle is on the x-axis). This circle represents the consolidation of the sample and the larger value of the crossing of the x-axis is called the consolidation stress σ_1 . The second Mohr touches the yield locus and the origin is a point of this circle. The value where the circle crosses the x-axis is called the unconfined yield strength σ_c . The flow factor ff_c can be calculated as ratio between the consolidation stress and the unconfined yield strength. Further details on the construction of the Mohr circles can be found in the book of D. Schulze cited above.

Both powders, of polymorph A (Probe 1) and C (Probe 2), show only a small difference in flow behaviour, yet polymorph C has a slight advantage, by flowing a bit better than polymorph A. The flow factors ff_c as obtained are illustrated in Figure 21.

Furthermore, the bulk density could be measured as follows:

5

Determination of bulk density during shear tests

Because of the normal stress of 1,5 kPa applied on the top of the lid during the shear test the lid lowers into the shear cell and compresses the powder.

During the shear tests this lowering of the lid is measured and recorded. Since the volume of the bottom ring is known and weight of the sample measured before the beginning of the shear test the bulk density of the sample during the shear test is calculated

$$\rho_{b, shear} = \frac{m_{ges} - m_{cell}}{(h_c - h_l) \cdot A_{cell}}$$

with:

- 15 $\rho_{b, shear}$: Bulk density under shear
- m_{ges} : total mass of shear cell including powder sample (w/o lid)
- m_{cell} : net mass of shear cell (w/o powder sample, w/o lid)
- h_c : height of the bottom ring
- h_l : lowering of lid
- 20 A_{cell} : bottom area of shear cell

The calculation of the bulk density is done automatically with the evaluation software provided together with the shear tester.

25 The result is illustrated by Figure 22, comparing $\rho(\text{shear})$ in $[\text{kg/m}^3]$ of polymorph A (probe 1) and polymorph C (probe 2).

A significant difference between polymorph A (Probe 1) and C (Probe 2) could be observed: polymorph A, represented by Probe 1 has only a bulk density of 270 kg/m^3 whereas polymorph C, represented by Probe 2, has a bulk density of about 550 kg/m^3 . This results in an unexpected significant advantage of polymorph C in view of polymorph A regarding the storage volume, as in the same volume the double amount of substance of polymorph C can be stored.

Example 5: Particle Size Distribution measured by Laser Diffraction of polymorphic forms A and C of (6S)-5-[4'-fluoro-2-(trifluoromethyl)biphenyl-4-yl]-6-methyl-3,6-dihydro-2H-1,3,4-oxadiazin-2-one, the compound of formula (I)

5 The particle size distribution was measured by laser diffraction using the Malvern Panalytical Mastersizer 3000.

The samples are again taken from example 1.6 (probe 1) and example 1.5 (probe 2), the same as used in example 4.

The sample to be analyzed is dispersed in 1 drop of Tween 80 the sample is processed according to ISO13320.

10 **Measurement of Particle Size Distribution (PSD) by Laser Diffraction**

Laser diffraction is an often-used method for determination the particle size of dispersed solid materials. A widened laser beam illuminates a cuvette which contains part of the particles. By diffraction on the particles a characteristic pattern can be mapped on the detector. The resulting diffraction image is the additive overlaying of diffraction images of all particles.

15 Besides the mentioned detector two additional detectors are mounted in order to detect diffraction light in forward direction (FA_{1,9}), in wide angle (LA_{1,2}) and in back direction (BS_{1,2}). The turbidity of the sample is measured by an extinction sensor. This is necessary to ensure a low particle concentration which is necessary to avoid wrong results by multiple diffraction of light at several particles.

20 The cuvette used was a wet unit where the suspension is pumped in a closed circuit with a dispersing unit that ensures a separation of single particles by shear forces.

The measurement range of the Malvern 3000 covers a particle size from 1 mm (2 mm) down to 20 nm

Calculation

25 The calculation of the particle size distribution from the diffraction patterns was done on basis of theory of Fraunhofer.

Basis of the Fraunhofer Theory is that the signal of the detector is only induced by diffraction, that means that the particles are completely opaque and spherical. This assumption is valid for particle sizes of 10 to 50 µm and above. For smaller particles the light scattering of the particle itself due to optical transparency must be considered which is done in the Mie-theory (not used for our probes). Precondition
30 of the application of the Mie-theory is the knowledge of the refractive and absorption index of the dispersed solids.

Resulting Figures

The results comparing particle size distributions between polymorph A and C are illustrated in Figure 23, wherein the y-axis shows the volume distribution Q3 [%] and the x-axis shows the particle size [μm], “ohne” means “without”,

- 5 Q3 is the cumulative volume distribution, e.g. D50 = Q(50 %) indicates 50 % of the volume part of the sample is smaller than particle size of 50 μm .

The particle size is expressed as an equivalent diameter used in the method recommended by the Malvern Analysis Program and as described in ISO13320.

Information about the graphs as shown in Figure 23 from left to the right:

- 10 - the first line (red line) relates to sample 1 (probe 1), polymorph A, with 300s ultrasound,
 - the second line (blue line) relates to sample 2 (probe 2), polymorph C, with 300s ultrasound
 - the third line (red dashed line) relates to sample 1 (probe 1), polymorph A, without ultrasound
 and
 - the fourth line (blue dashed line) relates to sample 2 (probe 2), polymorph C, without
 15 ultrasound.

The particle size distribution is surprisingly significantly different between the two polymorphs, without ultrasound treatment polymorph A has a significantly broader particle size distribution and larger particles, compared to polymorph C whereas after ultrasound treatment polymorph A has a significantly smaller particle size and broader distribution than polymorph C. This broad distribution translates into
 20 possible segregation effects of polymorph A during transport and processing, whereas narrow distribution of polymorph C reduces segregation effects. Also, a large influence of ultrasound treatment during measurement of polymorph A might indicate undesired fragility of particles compared to polymorph C.

Sample name	Probe 1	Probe 2	Probe 1	Probe2
Remark	Without Ultrasound (US)	Without US	300 s US	300 s US
D(10)	165	69,1	4,02	14,5
D(50)	404	179	44	57,3
D(90)	720	380	128	170

- 25 Dx=particle size, e.g. D(10) = particle size at Q3 = 10 % is 165 means that 10 % of the volume part of the sample is smaller than particle size of 165 μm .

The data of the following table are the basis for Figure 23, showing for 4 probes for certain **particle sizes D[μm]** (column 1) the **Cumulative Distribution Q3(x) [%]** in columns 2 - 5, whereby the conditions used for the probes are indicated as “without ultrasound (= US)” or “300 s US”:

<i>Probe name</i>	Probe 1	Probe 2	Probe 1	Porbe2
<i>Laser obscuration [%]</i>	12,18	9,44	23,63	22,79
<i>Particle size D [μm] / Cumulative volume distribution Q [%], Remark for condition</i>	without US	without US	300s US	300s US
0,01	0	0	0	0
0,0114	0	0	0	0
0,0129	0	0	0	0
0,0147	0	0	0	0
0,0167	0	0	0	0
0,0189	0	0	0	0
0,0215	0	0	0	0
0,0244	0	0	0	0
0,0278	0	0	0	0
0,0315	0	0	0	0
0,0358	0	0	0	0
0,0407	0	0	0	0
0,0463	0	0	0	0
0,0526	0	0	0	0
0,0597	0	0	0	0
0,0679	0	0	0	0
0,0771	0	0	0	0
0,0876	0	0	0	0
0,0995	0	0	0	0
0,113	0	0	0	0
0,128	0	0	0	0
0,146	0	0	0	0
0,166	0	0	0	0

0,188	0	0	0	0
0,214	0	0	0	0
0,243	0	0	0	0
0,276	0	0	0	0
0,314	0	0	0	0
0,357	0	0	0,06	0
0,405	0	0	0,15	0
0,46	0	0	0,27	0
0,523	0	0	0,42	0
0,594	0	0	0,62	0,08
0,675	0	0	0,85	0,2
0,767	0	0	1,14	0,33
0,872	0	0	1,46	0,5
0,991	0	0	1,84	0,67
1,13	0	0	2,26	0,86
1,28	0	0	2,74	1,04
1,45	0	0	3,26	1,21
1,65	0,07	0	3,84	1,37
1,88	0,14	0	4,48	1,52
2,13	0,23	0	5,18	1,67
2,42	0,32	0	5,97	1,83
2,75	0,43	0	6,84	2,02
3,12	0,56	0	7,8	2,24
3,55	0,69	0	8,87	2,49
4,03	0,84	0	10,03	2,8
4,58	1,01	0	11,28	3,16
5,21	1,18	0	12,61	3,57
5,92	1,37	0	14	4,05
6,72	1,56	0,06	15,43	4,6
7,64	1,76	0,13	16,9	5,22
8,68	1,97	0,2	18,38	5,91
9,86	2,17	0,27	19,88	6,7
11,2	2,38	0,35	21,41	7,61
12,7	2,6	0,43	22,99	8,67
14,5	2,81	0,52	24,65	9,93
16,4	3,03	0,66	26,43	11,44
18,7	3,24	0,85	28,38	13,29

21,2	3,45	1,12	30,55	15,54
24,1	3,66	1,51	33,01	18,26
27,4	3,86	2,02	35,82	21,51
31,1	4,09	2,66	39,04	25,33
35,3	4,33	3,42	42,69	29,7
40,1	4,62	4,3	46,79	34,58
45,6	4,97	5,3	51,31	39,87
51,8	5,38	6,44	56,19	45,48
58,9	5,84	7,78	61,32	51,26
66,9	6,34	9,44	66,6	57,08
76	6,84	11,6	71,86	62,81
86,4	7,31	14,47	76,95	68,33
98,1	7,71	18,26	81,73	73,52
111	8,06	23,13	86,06	78,28
127	8,42	29,12	89,81	82,52
144	8,94	36,15	92,92	86,16
163	9,85	43,99	95,36	89,2
186	11,47	52,3	97,15	91,66
211	14,12	60,66	98,37	93,62
240	18,13	68,67	99,12	95,18
272	23,71	75,96	99,54	96,46
310	30,88	82,27	99,76	97,5
352	39,48	87,49	99,87	98,37
400	49,13	91,58	99,94	99,05
454	59,27	94,65	100	99,55
516	69,25	96,82	100	99,86
586	78,43	98,26	100	100
666	86,25	99,16	100	100
756	92,34	99,65	100	100
859	96,59	99,9	100	100
976	99,14	100	100	100
1110	100	100	100	100
1260	100	100	100	100
1430	100	100	100	100
1630	100	100	100	100
1850	100	100	100	100
2100	100	100	100	100

2390	100	100	100	100
2710	100	100	100	100
3080	100	100	100	100
3500	100	100	100	100

Figure 24A shows particle size distributions of the sample of polymorph A without ultrasound treatment (measured three times) and after different times of ultrasound treatment. The green curves in the right side of the diagram are reflecting the measurement without ultrasound treatment and almost lie one above the other whereas curves reflecting the particle size distribution depending on the ultrasound treatment time, 15 s, 60 s, 180 s and 300 s, results in different curves showing the volume distribution moving from the right to the left, also indicated by D(50) becoming smaller and smaller when the treatment time became longer

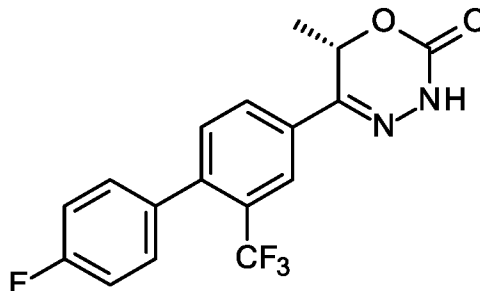
Figure 24B shows particle size distribution of polymorph C without ultrasound treatment (measured three times) and after different times of ultrasound treatment. The green curves reflecting the measurement without ultrasound treatment almost lie one above the other whereas curves reflecting the particle size distribution depending on the ultrasound treatment time, 15 s, 60 s, 180 s and 300 s, results in different curves showing the volume distribution moving from the right to the left, also indicated by D(50) becoming smaller and smaller when the treatment time became longer.

The difference between the Q3[50] of the untreated samples and the sample treated 300 s with ultrasound is different for polymorph A and polymorph C. Whereas for polymorph A the difference is large the difference for polymorph C is significantly smaller.

Furthermore the amount of fines after US treatment of 300 s is significantly larger for polymorph A than for polymorph C indicated by a much smaller values of D(10 %), D(20 %) and D(30 %). Altogether this indicates that the crystals of polymorph C are more robust than those of polymorph A translating into less abrasion during any processing and hence loss of material which is a significant advantage for handling the polymorph C e.g. for weighting, granulation, transport through pipes, to fill up the active ingredient for transport, for preparation of a composition for treatment.

What is claimed is:

1. A crystalline form of the compound of the formula (I)



5 (I)

which is the polymorph C characterized by a X-ray powder diffractogram measured at 25°C and with Cu-K alpha 1 as radiation source displaying at least the following reflections, quoted as $^{\circ}2\theta$ value $\pm 0.2^{\circ}$: 21,1; 15,1; 22,6.

2. The polymorph C of the compound of formula (I) according to claim 1 characterized by a
10 X-ray powder diffractogram measured at 25°C and with Cu-K alpha 1 as radiation source displaying at least the following reflections, quoted as $^{\circ}2\theta$ value $\pm 0.2^{\circ}$: 21,1; 15,1; 22,6; 18,8; 26,8.
3. The polymorph C of the compound of formula (I) according to claim 1 characterized by a
15 X-ray powder diffractogram measured at 25°C and with Cu-K alpha 1 as radiation source displaying at least the following reflections, quoted as $^{\circ}2\theta$ value $\pm 0.2^{\circ}$: 21,1; 15,1; 22,6; 18,8; 26,8; 22,6; 18,9.
4. The polymorph C of the compound of formula (I) according to claim 1 characterized by a
20 X-ray powder diffractogram measured at 25°C and with Cu-K alpha 1 as radiation source displaying at least the following reflections, quoted as $^{\circ}2\theta$ value $\pm 0.2^{\circ}$: 21,1; 15,1; 22,6; 18,8; 26,8; 22,6; 18,9; 29,8; 11,9; 31,6.
5. The polymorph C of the compound of formula (I) according to claim 1 characterized by Raman spectroscopy measured at 25°C displaying at least the following reflections: 1606, 1617, 141 [cm^{-1}]
6. The polymorph C of the compound of formula (I) according to claim 1 characterized by
25 Raman spectroscopy measured at 25°C displaying at least the following bands: 1606, 1617, 141, 92, 1272 [cm^{-1}].

7. The polymorph C of the compound of formula (I) according to claim 1 characterized by Raman spectroscopy measured at 25°C displaying at least the following bands: 1606, 1617, 141, 92, 1272, 120, 1328 [cm⁻¹].
- 5 8. The polymorph C of the compound of formula (I) according to claim 1 characterized by Raman spectroscopy measured at 25°C displaying at least the following bands: 1606, 1617, 141, 92, 1272, 120, 1328, 812, 1095, 1298 [cm⁻¹]
- 10 9. A pharmaceutical composition comprising the crystalline form of the compound of formula (I) which is polymorph C characterized by a X-ray powder diffractogram measured at 25°C and with Cu-K alpha 1 as radiation source displaying at least the following reflections, quoted as °2Θ value ± 0.2°: 21,1; 15,1; 22,6 and optionally further pharmaceutically acceptable excipients.
- 15 10. The pharmaceutical composition of claim 10 comprising polymorph C of the compound of the formula (I) mainly and no significant fractions of another form of the compound of formula (I) and optionally further pharmaceutically acceptable excipients
- 20 11. The pharmaceutical composition according to claim 10 comprising polymorph C of the compound of formula (I) mainly and less than 15 % of another form or other forms of the compound of formula (I) and optionally further pharmaceutically acceptable excipients.
12. The pharmaceutical composition according to claim 12, wherein the amount of another form or other forms of the compound of formula (I) is less than 10 %.
- 25 13. The pharmaceutical composition according to claim 12, wherein the amount of another form or other forms of the compound of formula (I) is less than 5 %.
14. A crystalline form which is polymorph C of the compound of formula (I) according to anyone of claims 1 to 9 for use in the treatment and/or prophylaxis of diseases.
15. The crystalline form which is polymorph C for use according to claim 15, whereby the disease is a hyperproliferative diseases.
- 30 16. The crystalline form which is polymorph C for use according to claim 16, whereby the hyperproliferative disease is a cancer disease.
17. The crystalline form for use according to claim 16, whereby the cancer disease is selected from brain cancer, breast cancer, cervical cancer, head and neck cancer, leukemia, AML, lung cancer, lymphoma, skin cancer, esophageal carcinoma, ovarian cancer, pancreas cancer, prostate cancer and sarcoma.

18. The pharmaceutical composition of claim 10 to 12 for use in the treatment of a hyperproliferative disease.
19. The pharmaceutical composition for use according to claim 19, whereby the hyperproliferative disease is a cancer disease.
- 5 20. The pharmaceutical composition for use according to claim 20, whereby the cancer disease is selected from brain cancer, breast cancer, cervical cancer, head and neck cancer, leukemia, AML, lung cancer, lymphoma, skin cancer, esophageal carcinoma, ovarian cancer, pancreas cancer, prostate cancer and sarcoma.
- 10 21. The crystalline form which is polymorph C for use as defined in anyone of claims 15 to 18 for the manufacture of a pharmaceutical composition for the treatment or prevention of brain cancer, breast cancer, cervical cancer, head and neck cancer, leukemia, AML, lung cancer, lymphoma, skin cancer, esophageal carcinoma, ovarian cancer, pancreas cancer, prostate cancer and sarcoma.
- 15 22. Use of a compound as defined in any of claims 1 to 9 for the manufacture of a pharmaceutical composition for the treatment or prevention of a cancer disease.
23. Use of a compound as defined in any of claims 1 to 9 for the manufacture of a stable pharmaceutical composition.
- 20 24. A method of treating or preventing of hyperproliferative diseases in a mammal, comprising administering to a mammal in need thereof a therapeutically effective amount of polymorph C of the compound of formula (I) according to claim 1.

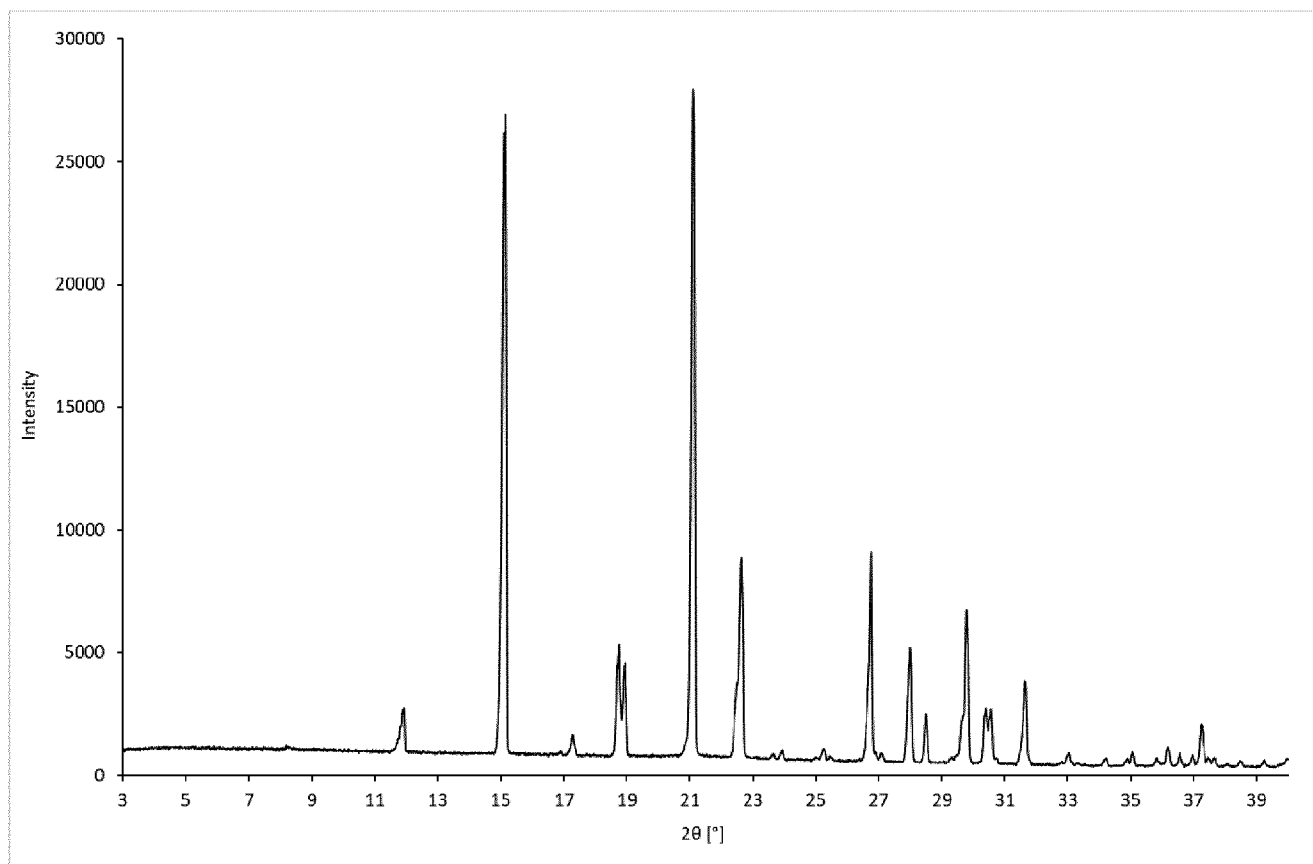
FIG 1: XRPD modification C according to example 1.5; Intensity vs 2θ [°]

FIG. 1

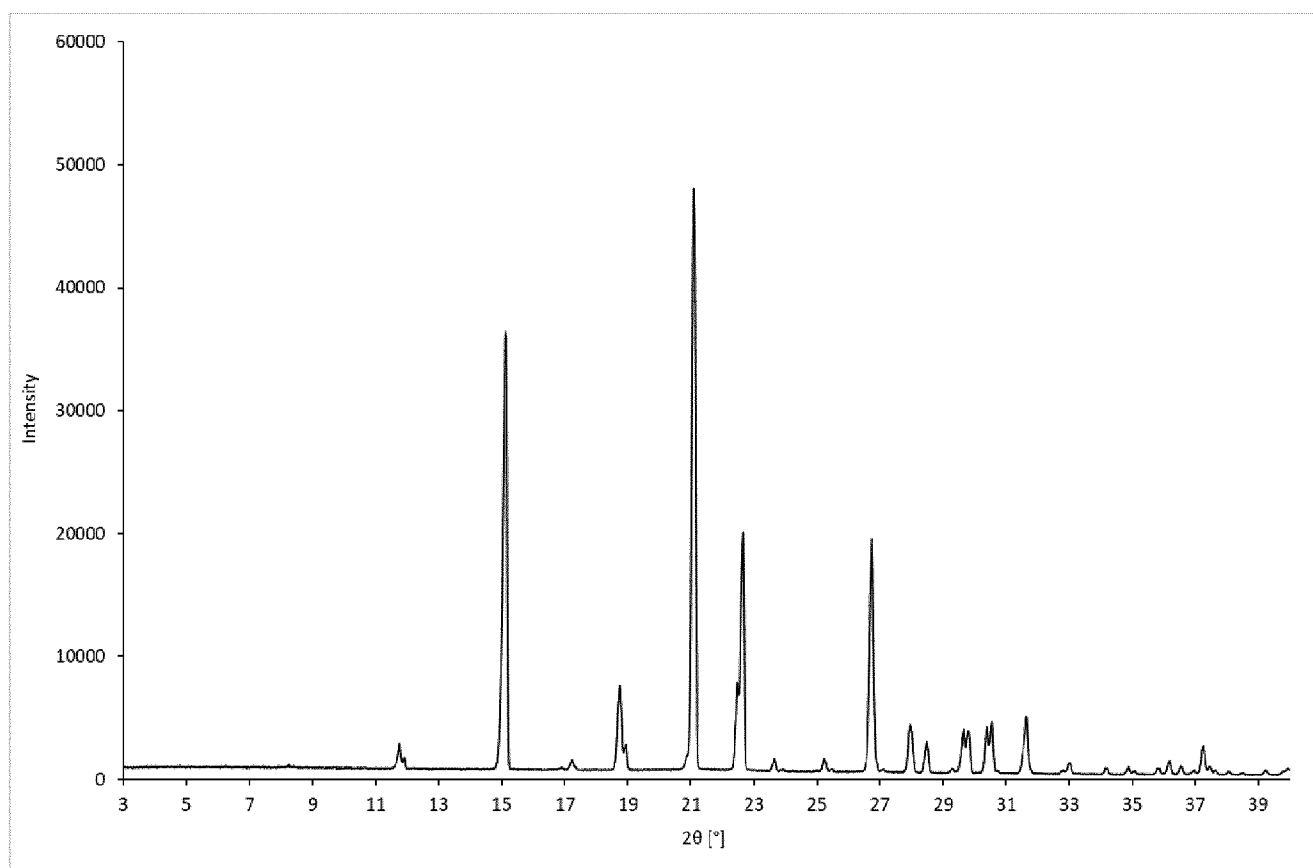
FIG 2: XRPD modification C according to example 1.5, repeated batch; Intensity vs 2θ [°]

FIG. 2

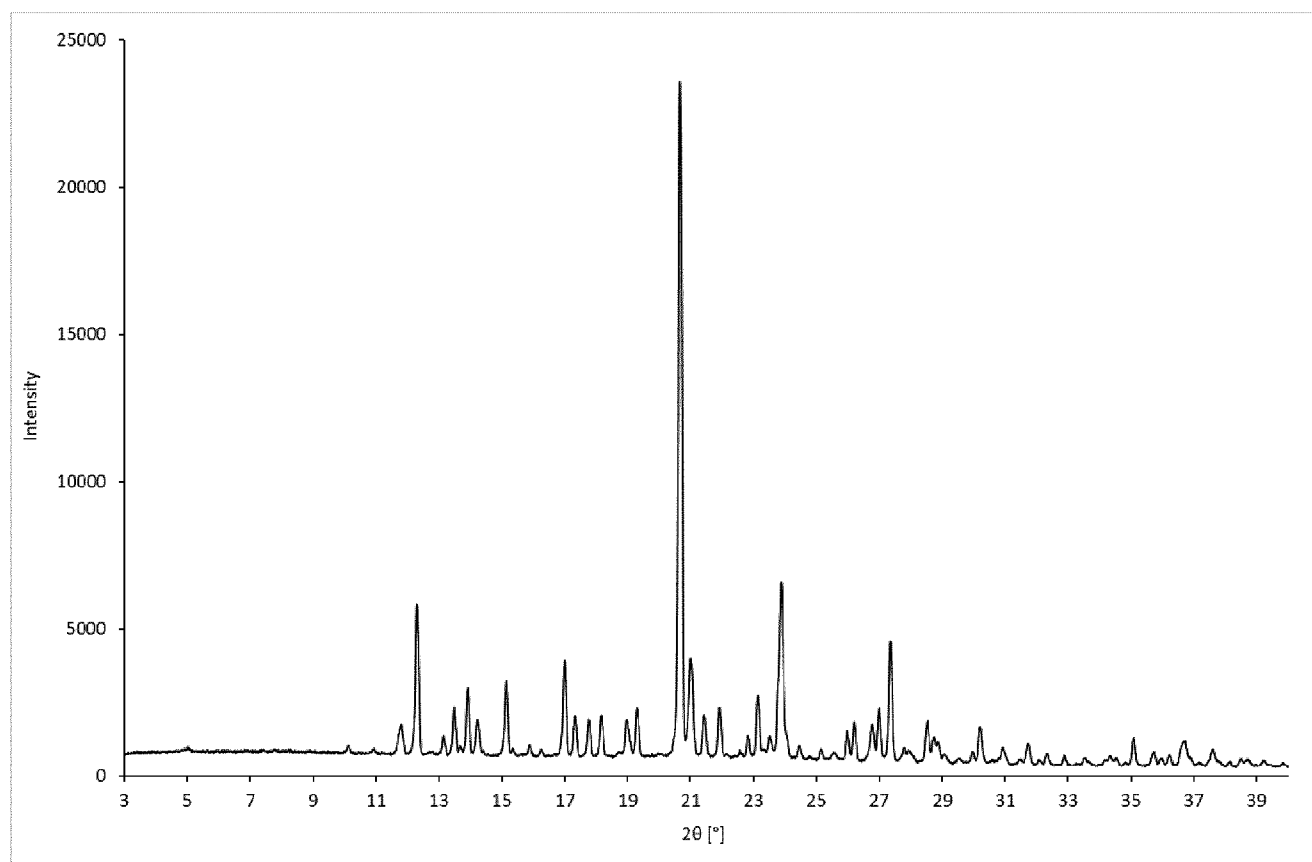
FIG 3: XRPD modification A according to example 1.6; Intensity vs 2θ [°]

FIG. 3

FIG 4: XRPD modification B according to example 1.7

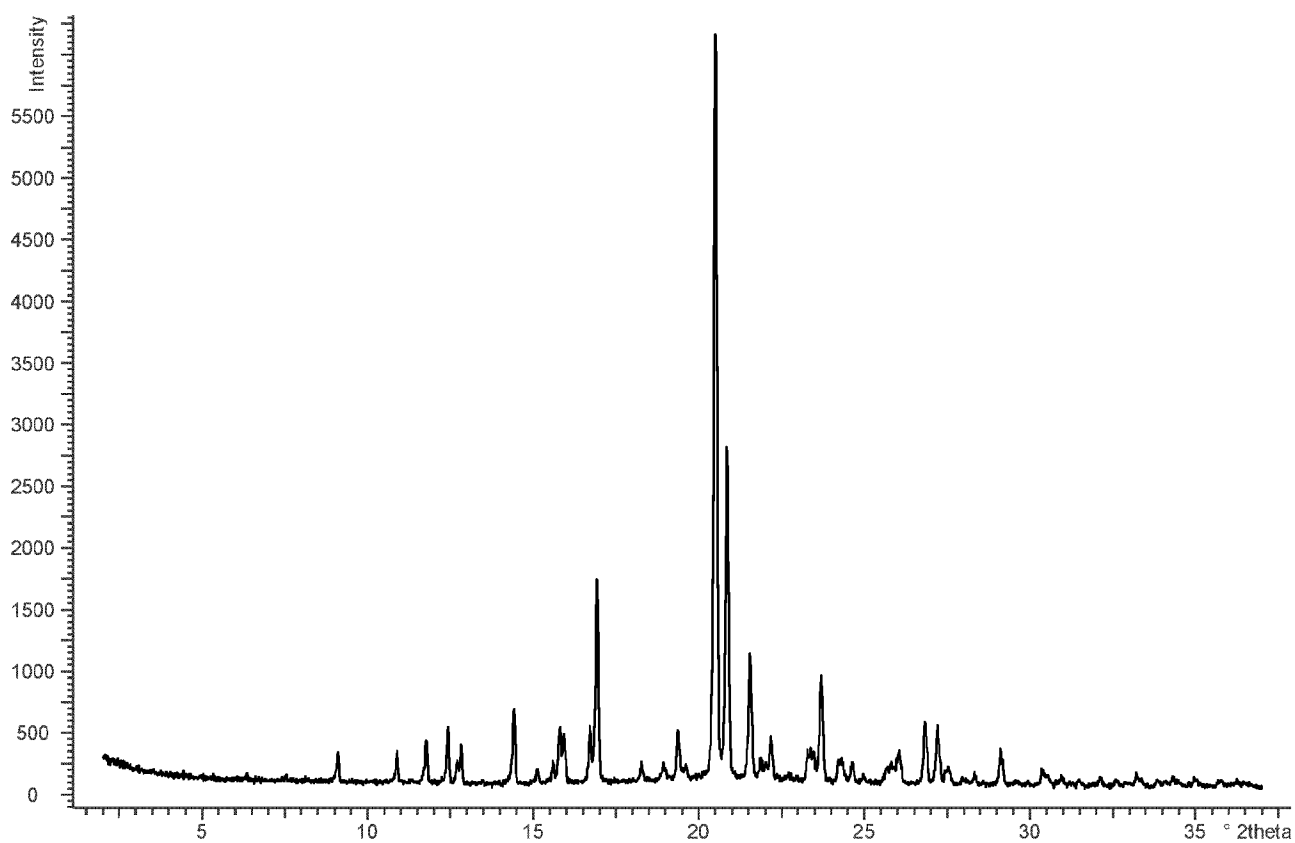


FIG. 4

FIG 5: XRPD modification B according to example 1.8, 1)

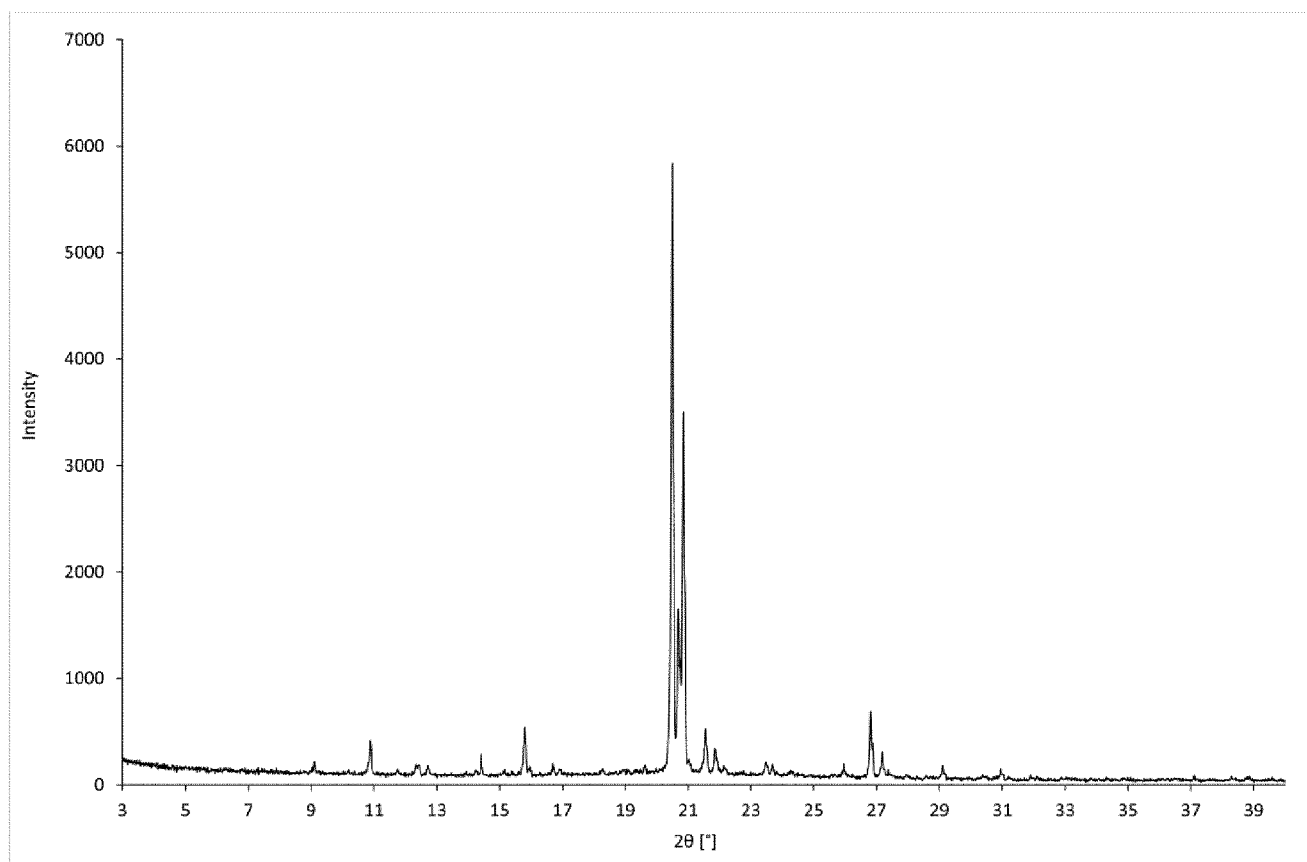


FIG. 5

FIG 6: XRPD modification C according to example 1.8, 2)

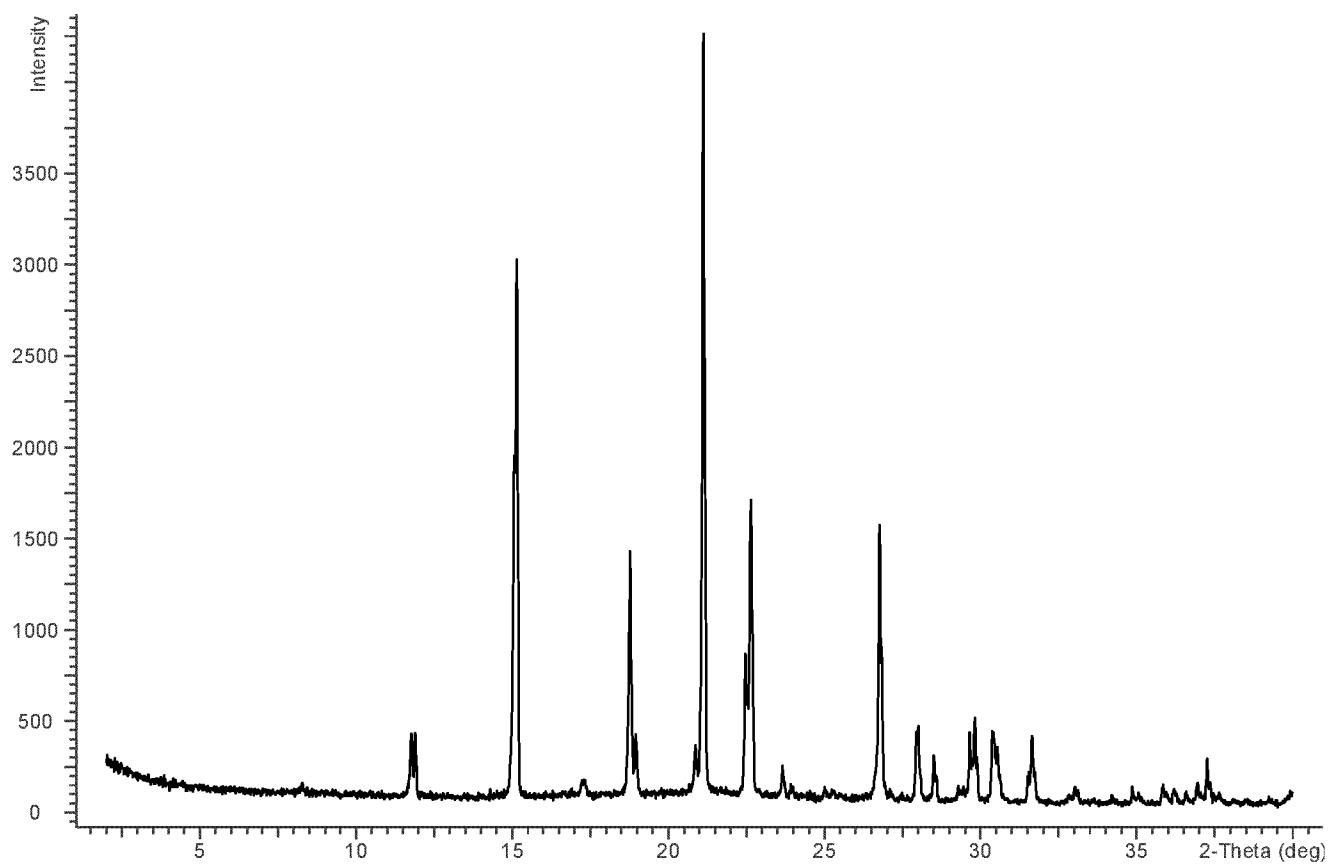


FIG. 6

FIG 7: XRPD modification A according to example 2.1/table in example 3.1

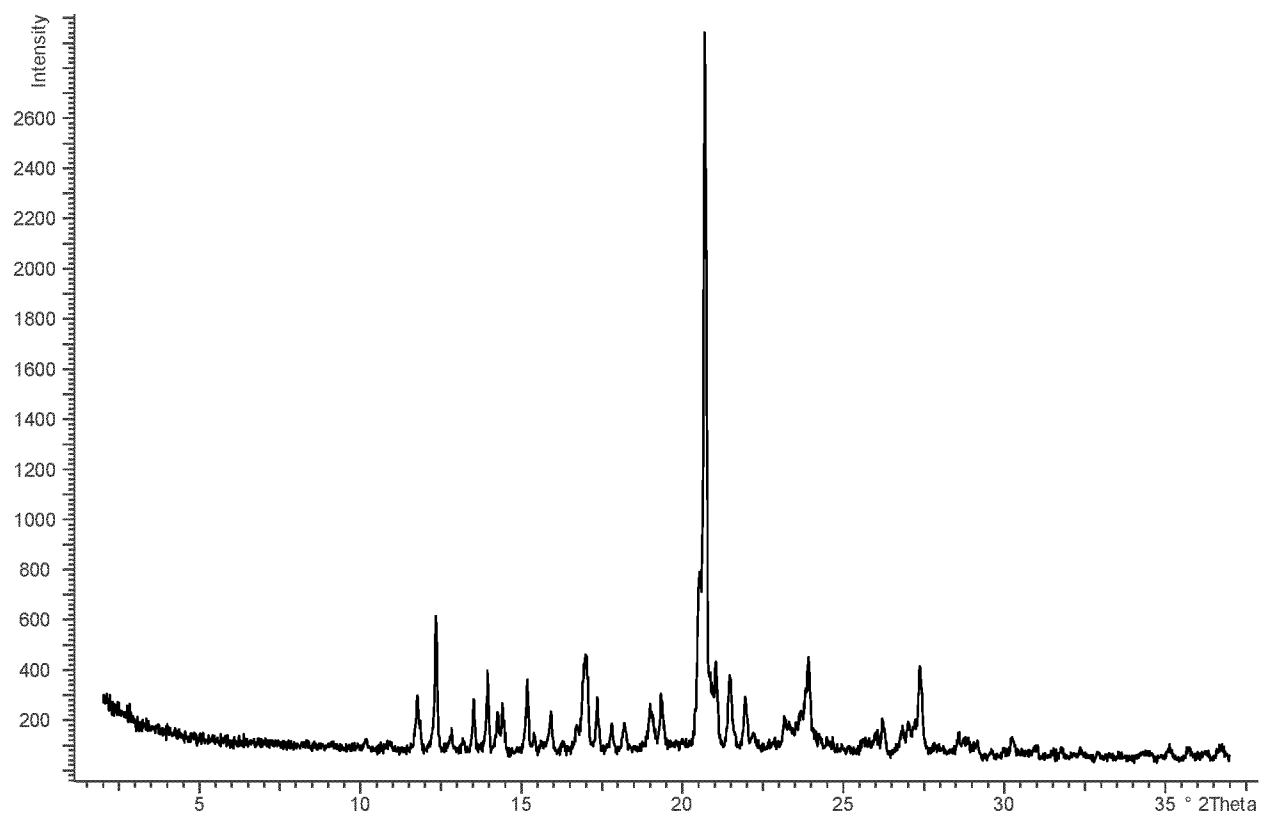


FIG. 7

FIG 8: XRPD modification B according to example 2.2/table in example 3.1

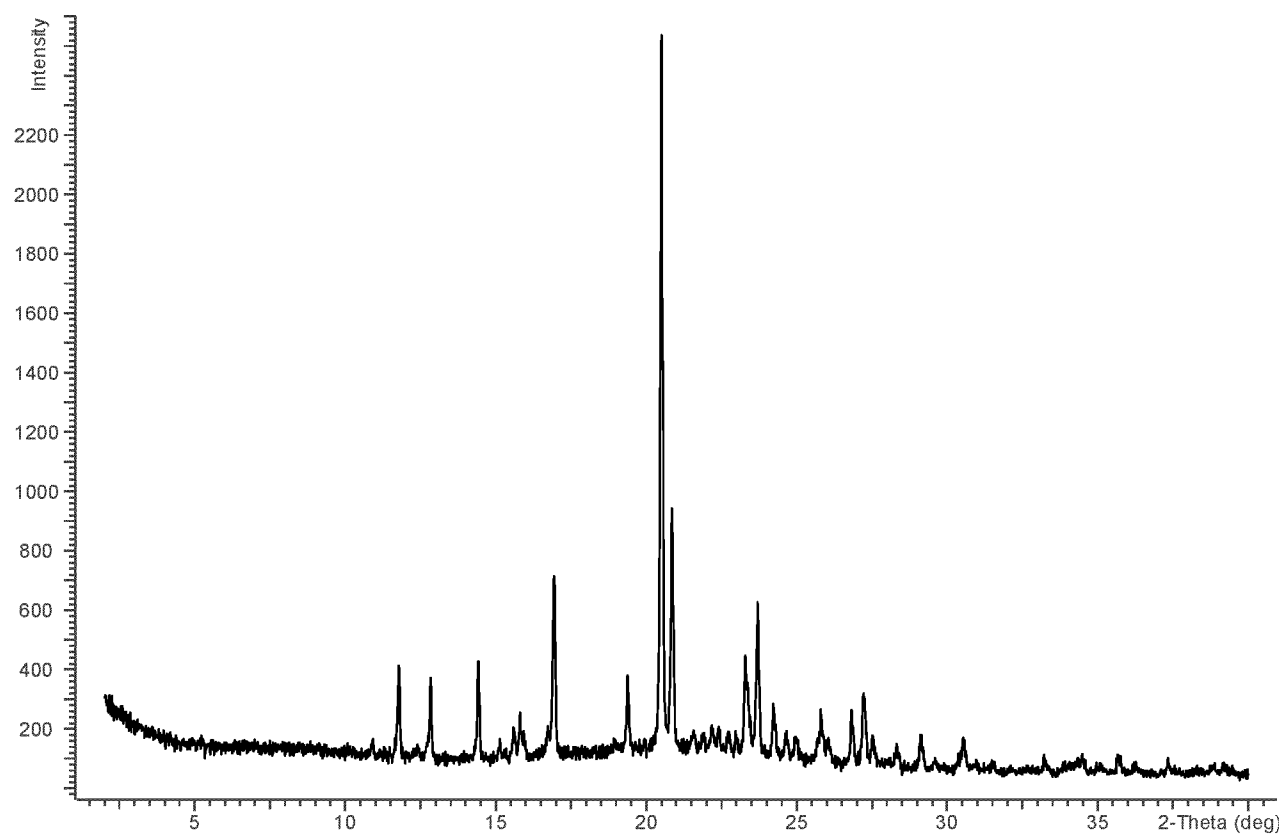


FIG. 8

FIG 9: XRPD modification C according to example 2.3/ table in example 3.1

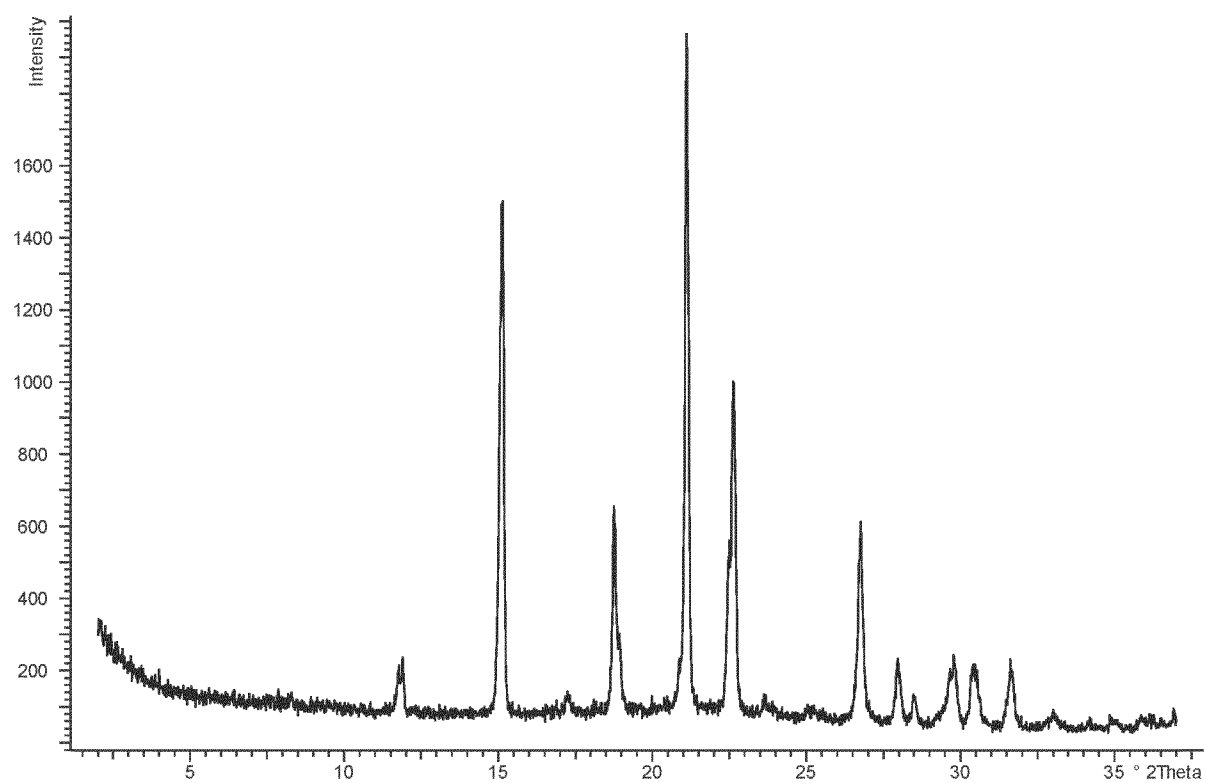


FIG. 9

FIG 10: IR spectrum of modification A according to example 2.1/ table in example 3.2

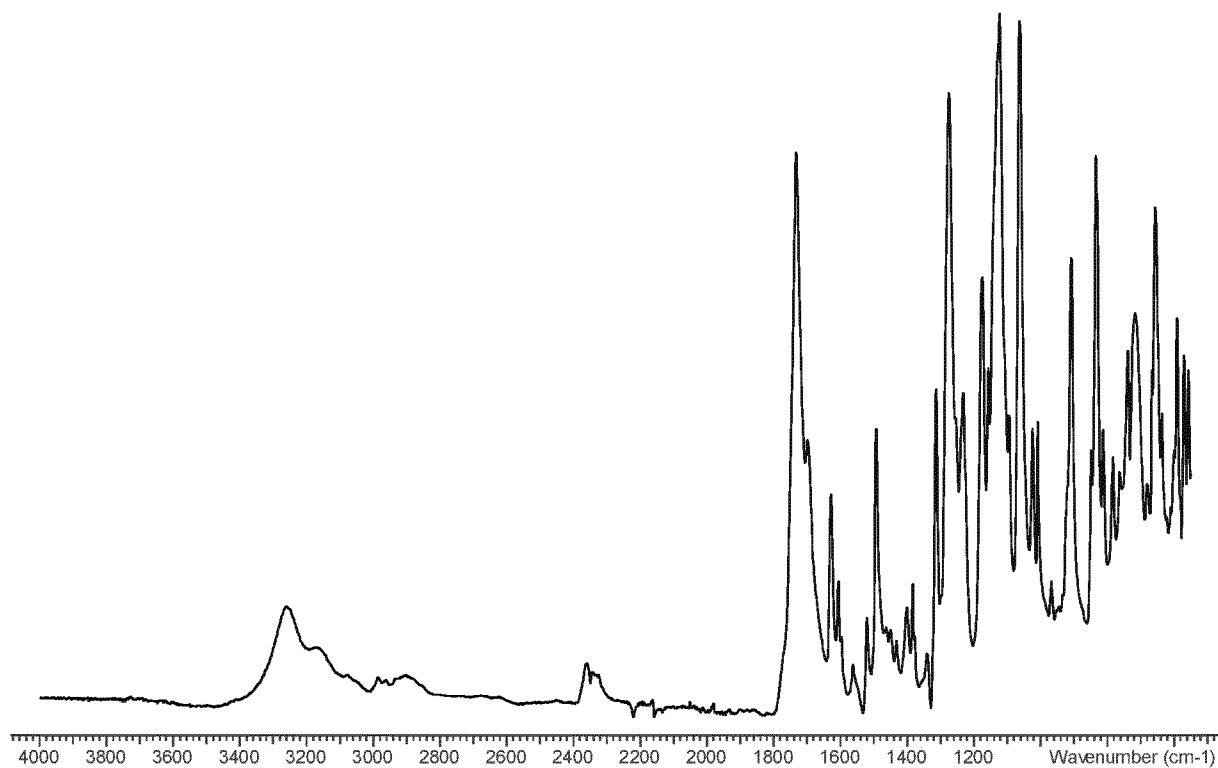


FIG. 10

FIG 11: IR spectrum of modification B according to example 2.2 / table in example 3.2

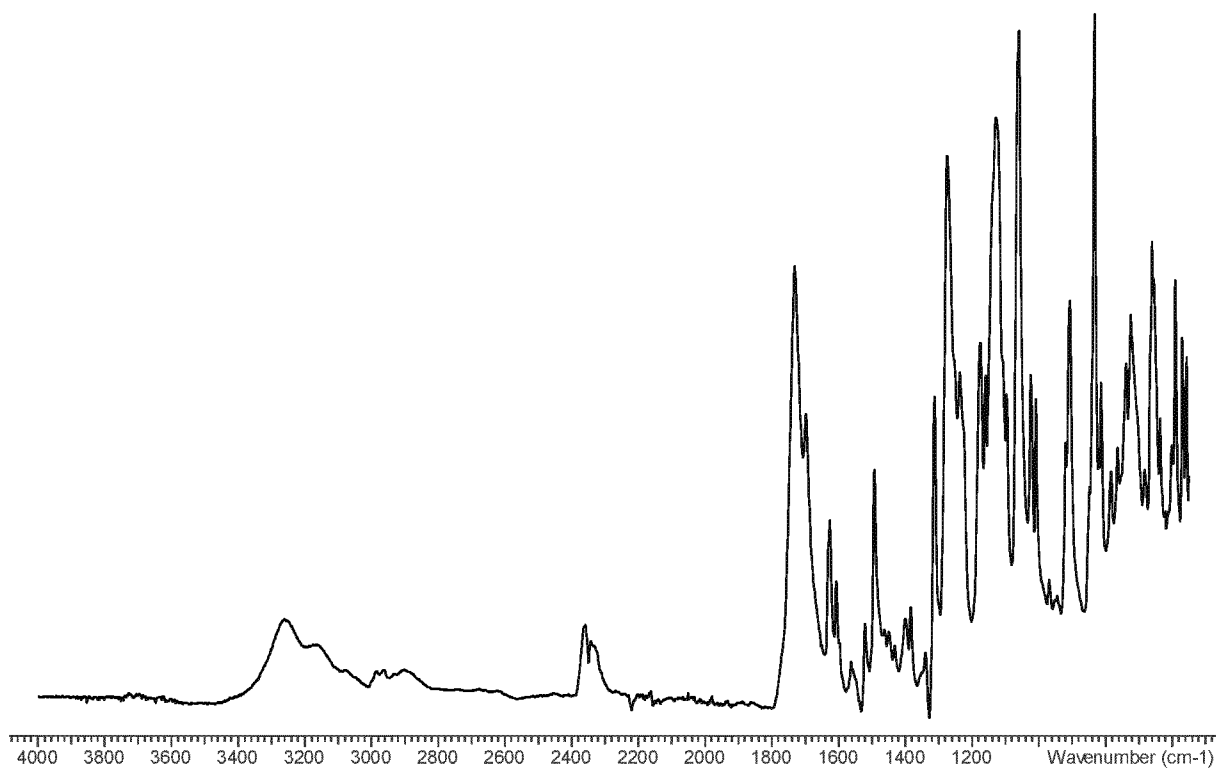


FIG. 11

FIG 12: IR spectrum of modification C according to example 2.3 / table in example 3.2

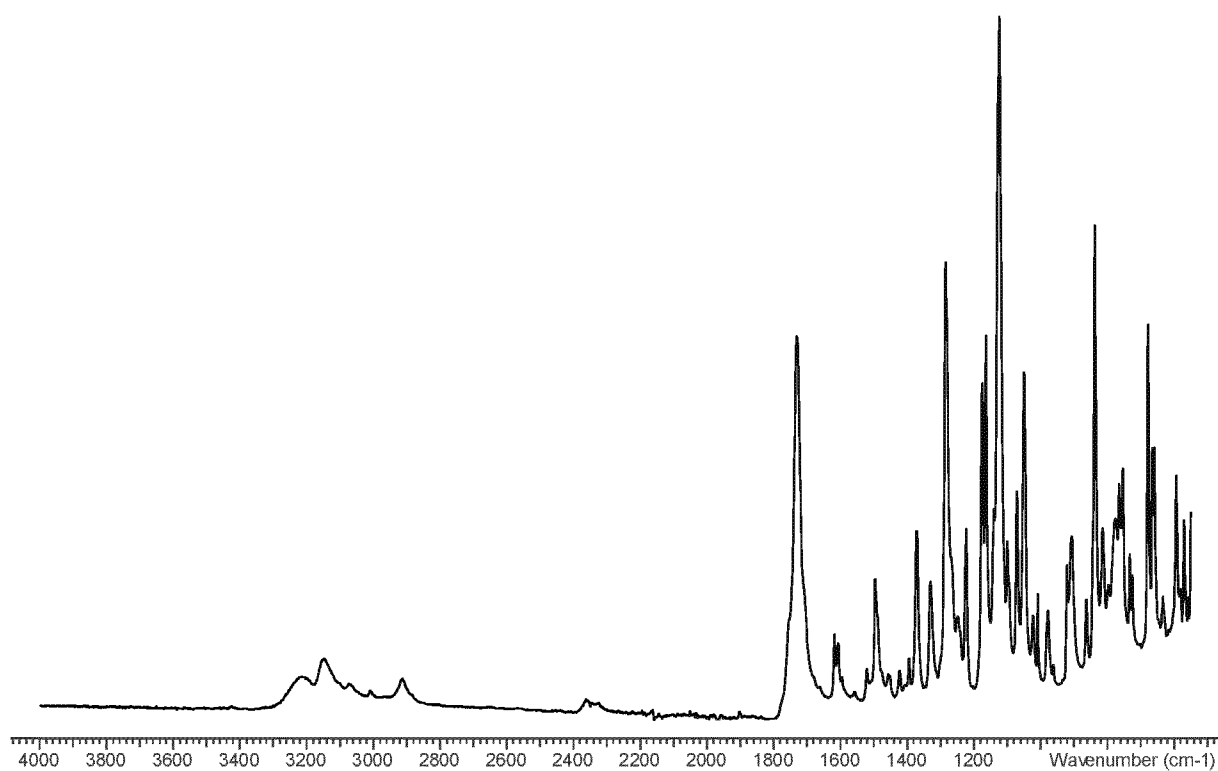


FIG. 12

FIG 13: Raman spectrum of modification A according to example 2.1 / table in example 3.3

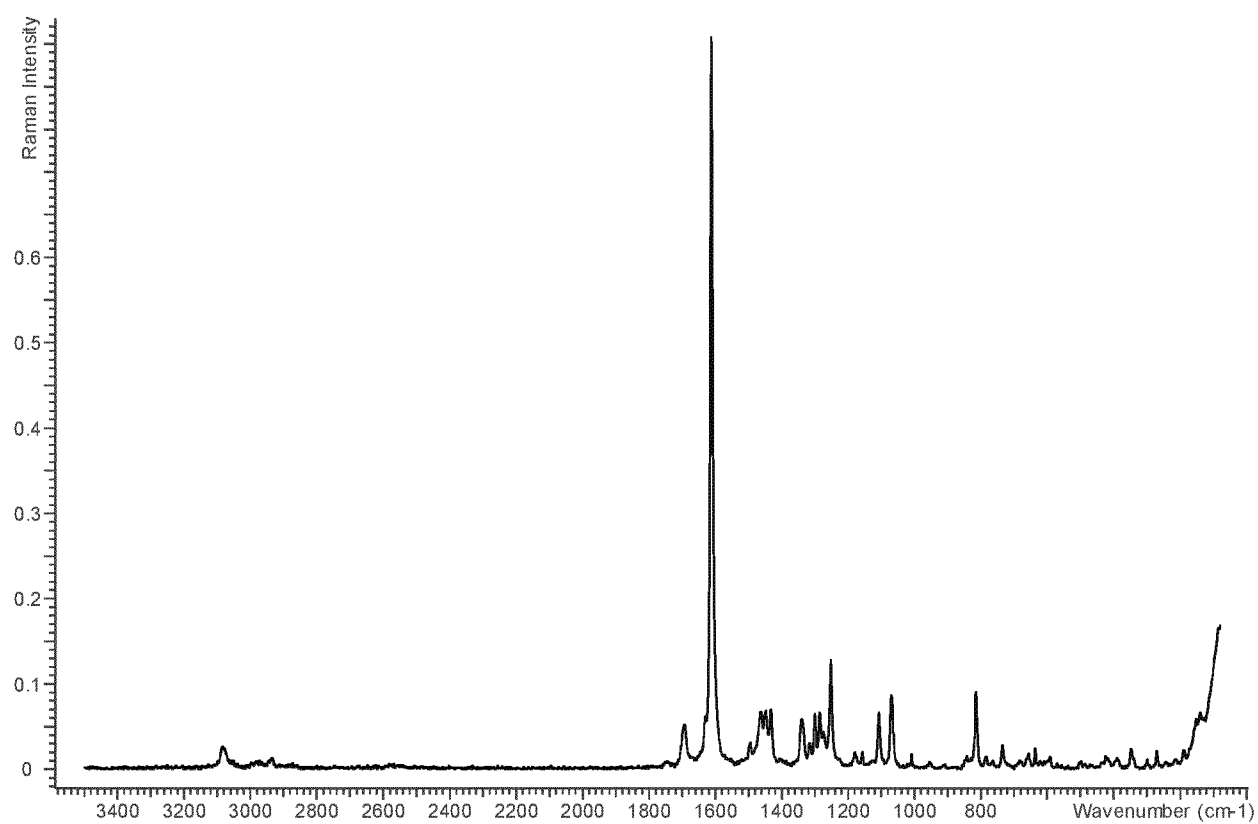


FIG. 13

FIG 14: Raman spectrum of modification B according to example 2.2 / table in example 3.3

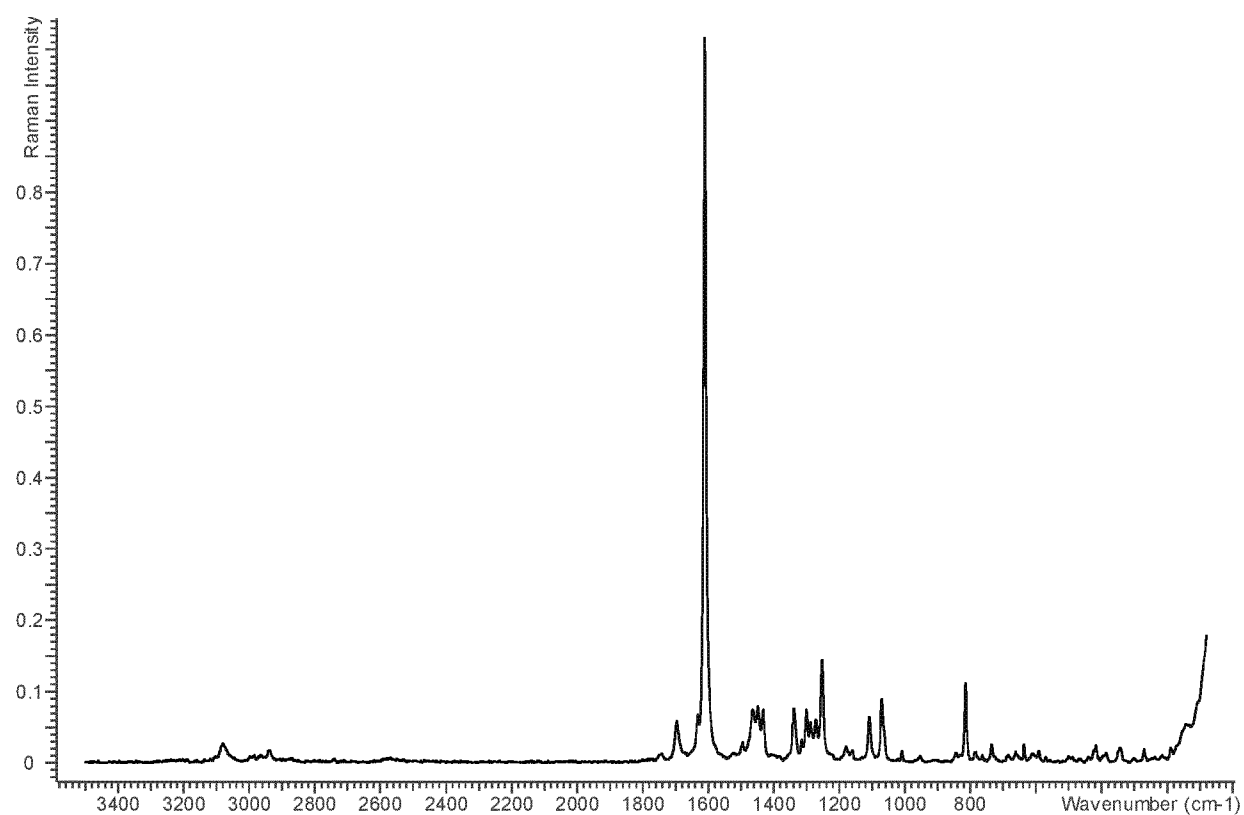


FIG. 14

FIG 15: Raman spectrum of modification C according to example 2.3 / table in example 3.3

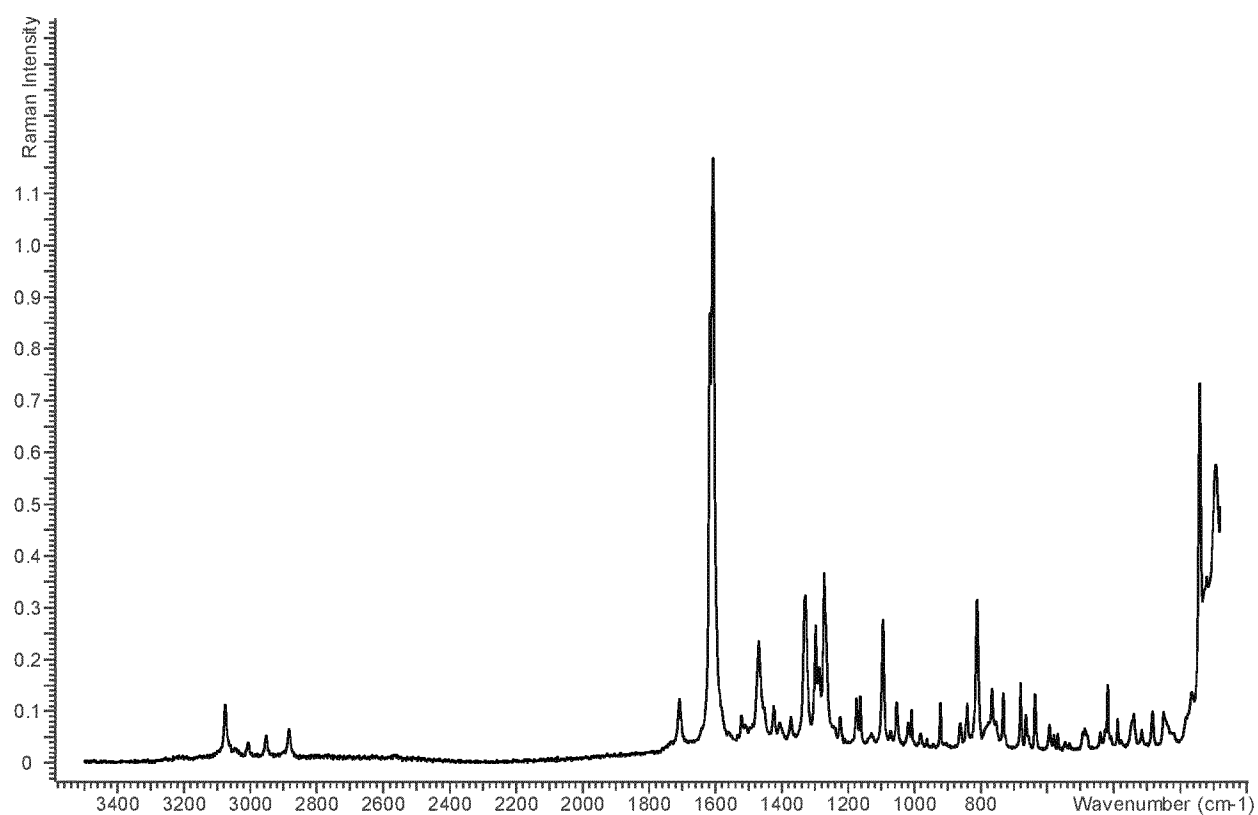


FIG. 15

FIG 16: DSC- and TGA-Thermogram of modification A according to example 2.1

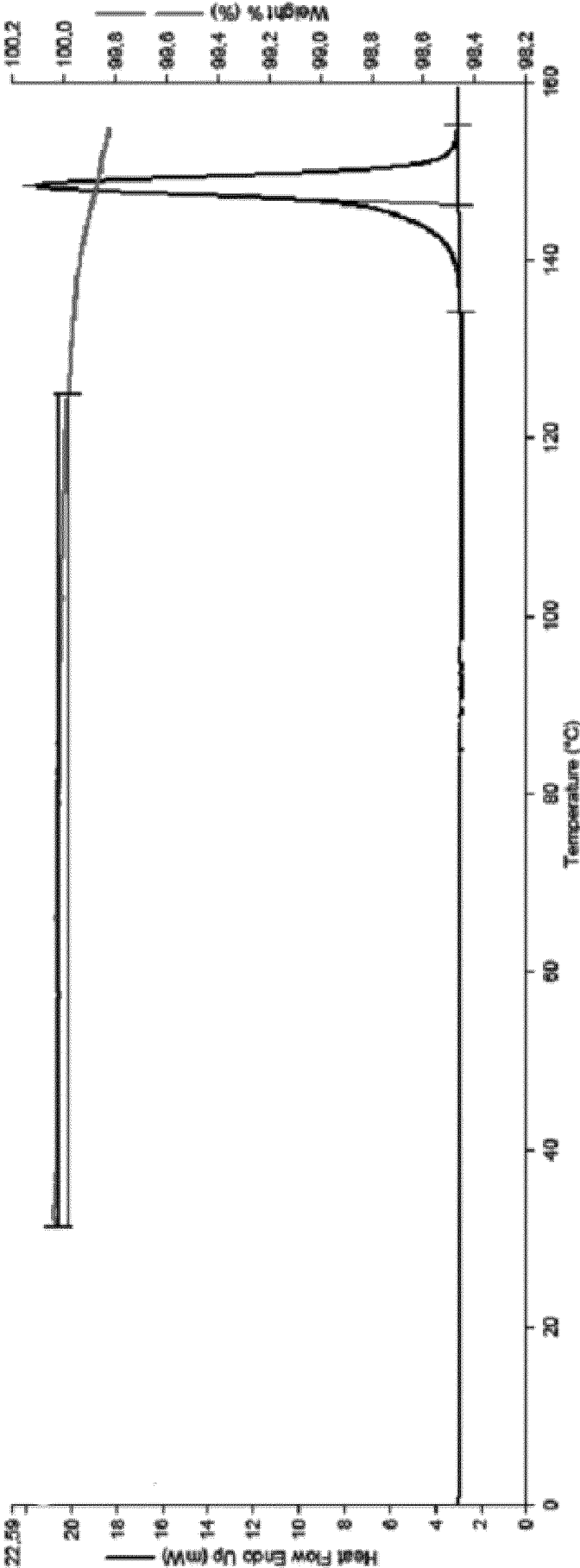


FIG. 16

FIG 17: DSC- and TGA-Thermogram of modification B according to example 2.2

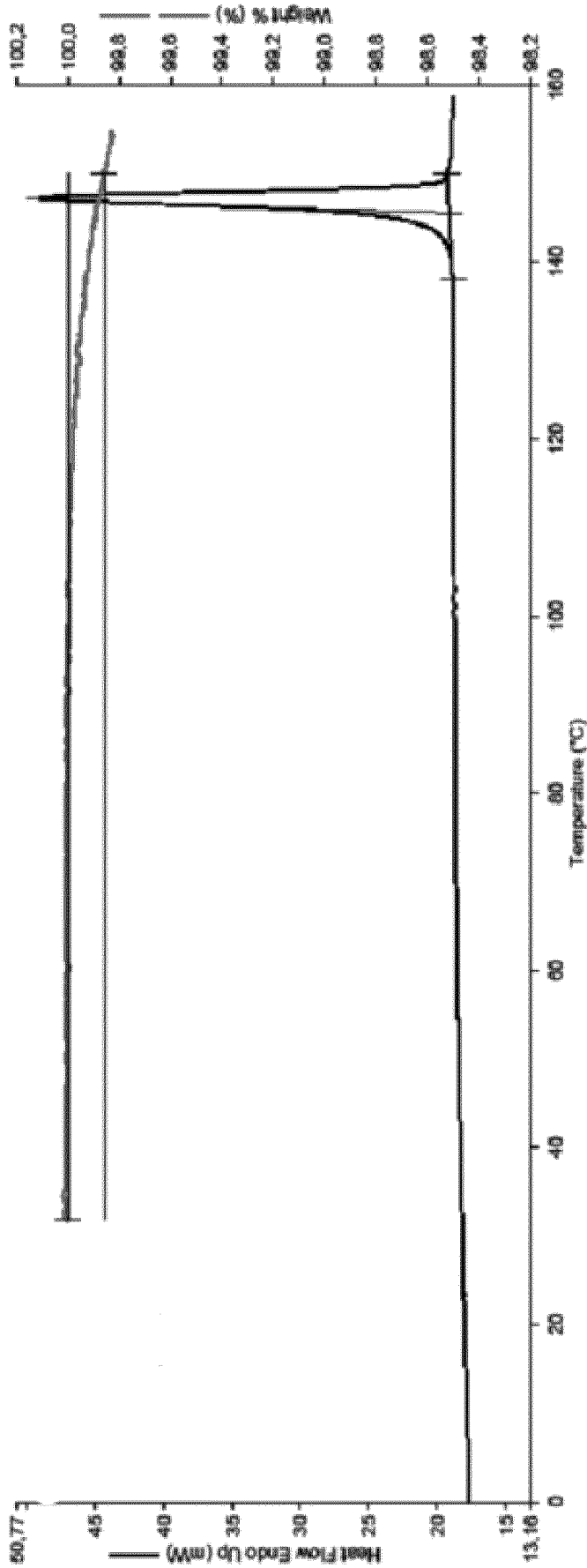


FIG. 17

FIG 18: DSC- and TGA-Thermogram of modification C according to example 2.3

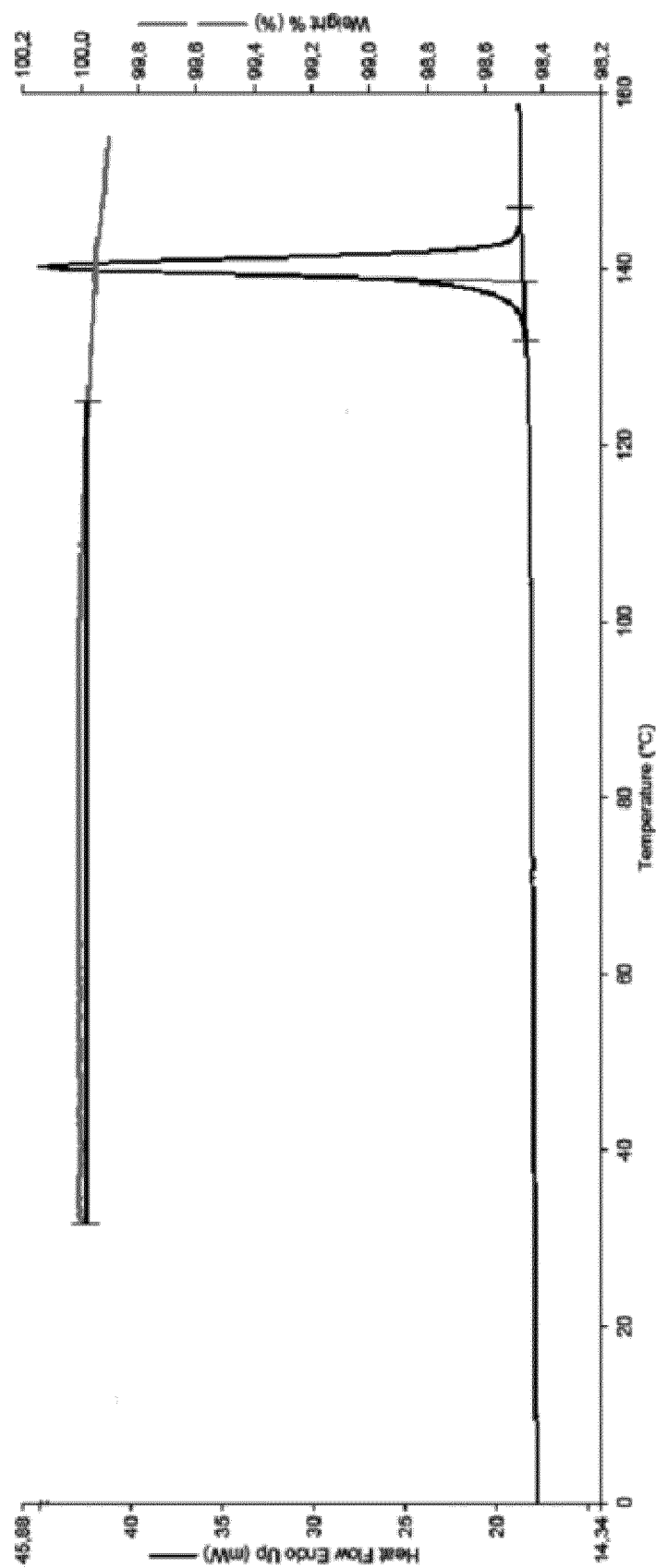


FIG. 18

FIG 19A: Schulze Ring Shear Tester

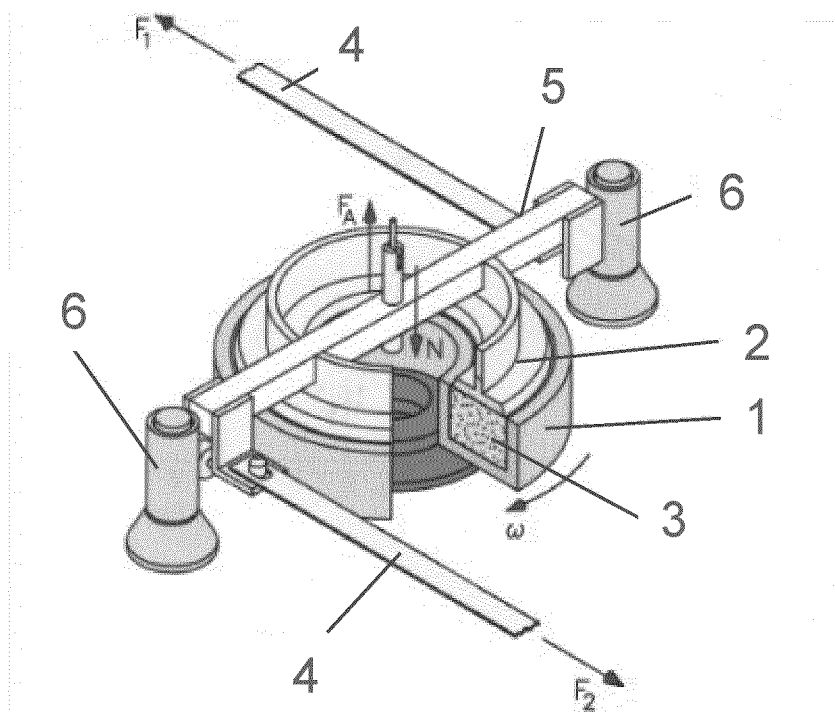


FIG. 19A

FIG. 19B: Shear Cell XS-SV3

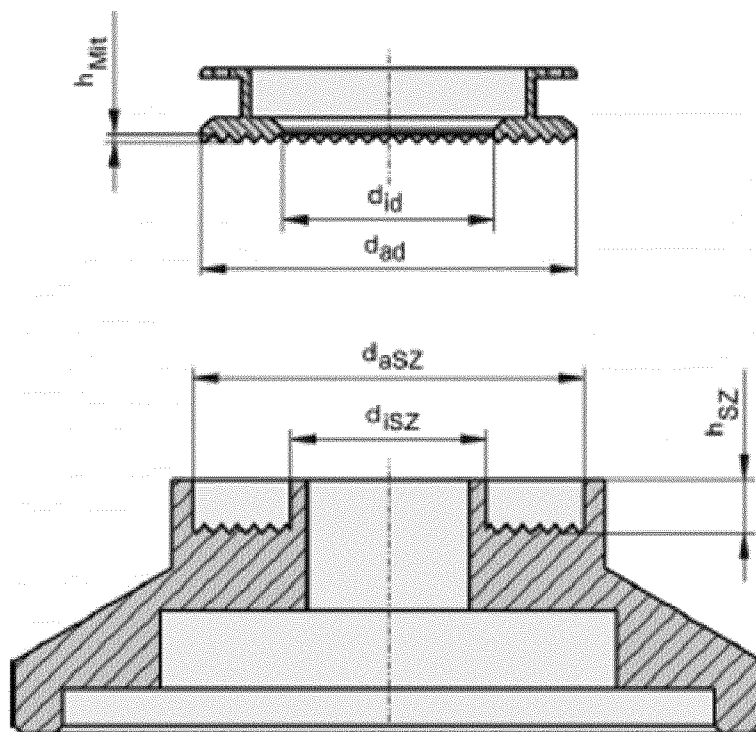


FIG 19B

FIG 20: Result of the Schulze Ring Shear Test

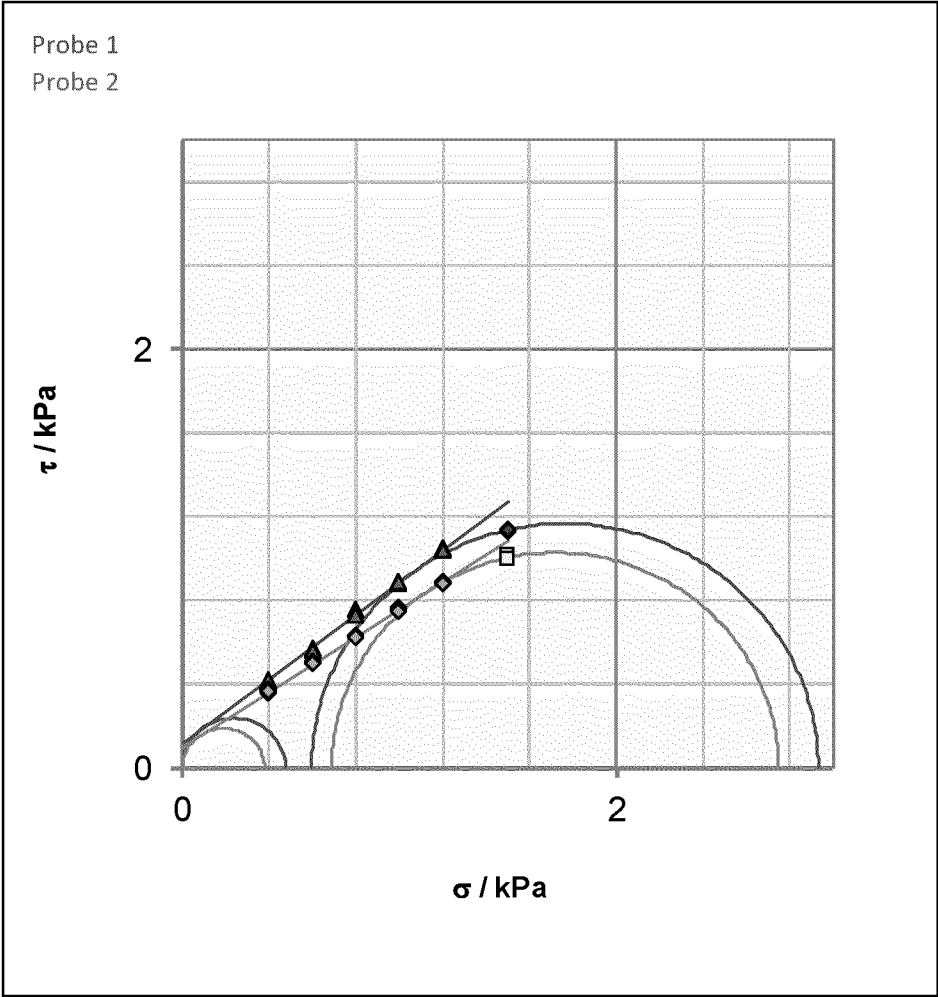


FIG.20

FIG 21: Flow Factor

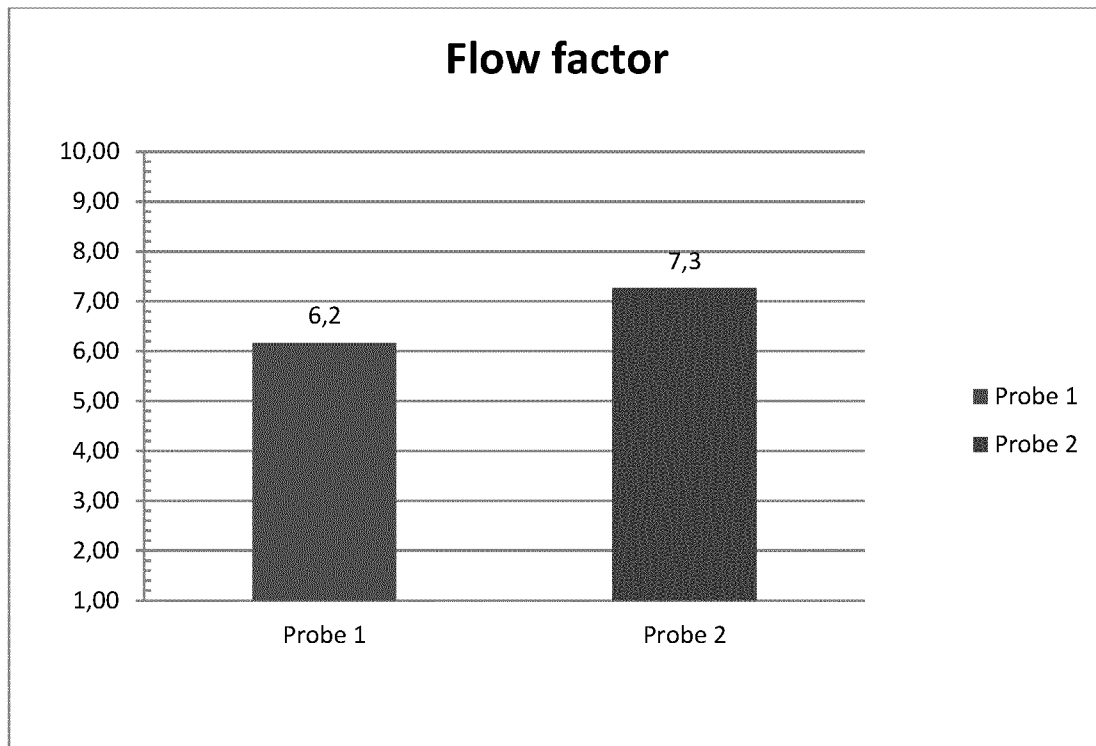


FIG.21

FIG 22: Bulk density

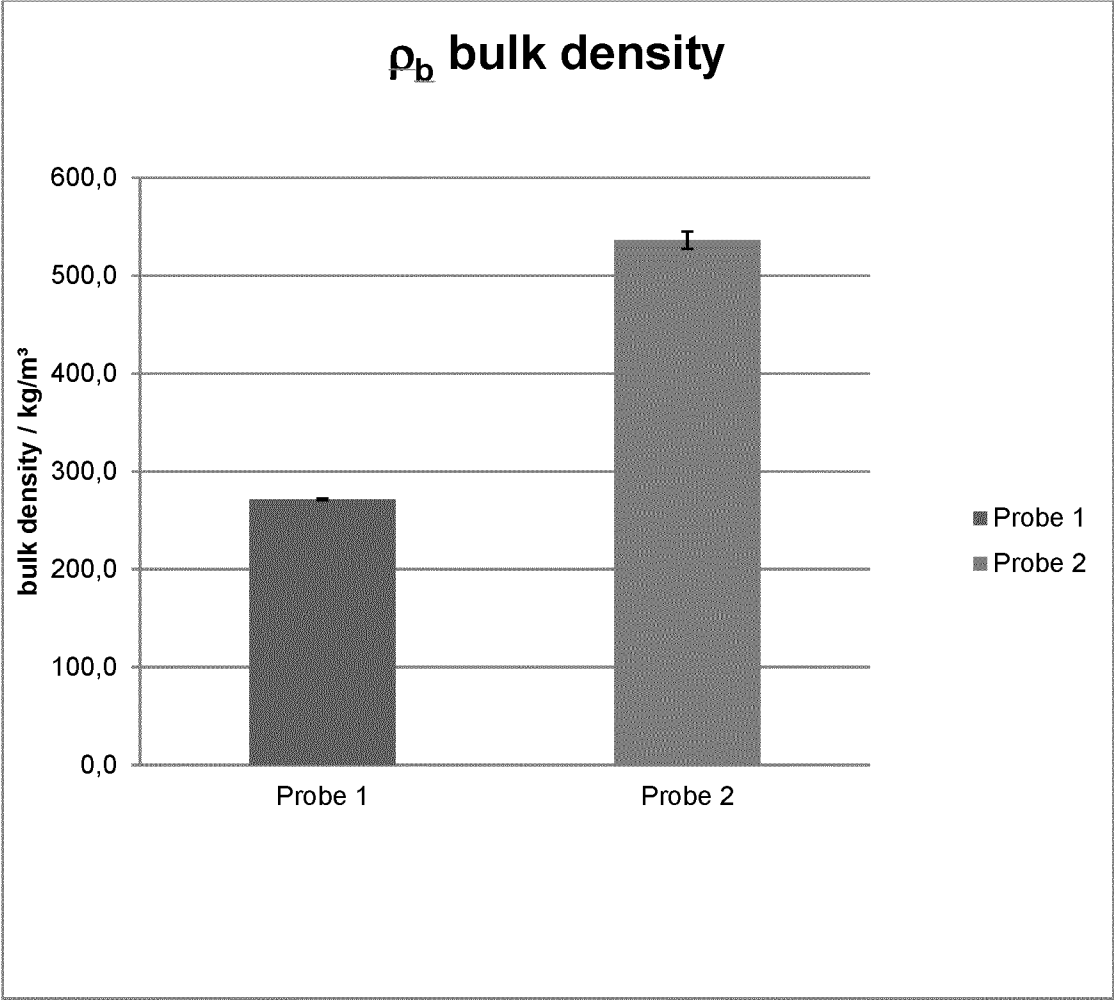


FIG.22

FIG 23: Comparison of particle size distribution

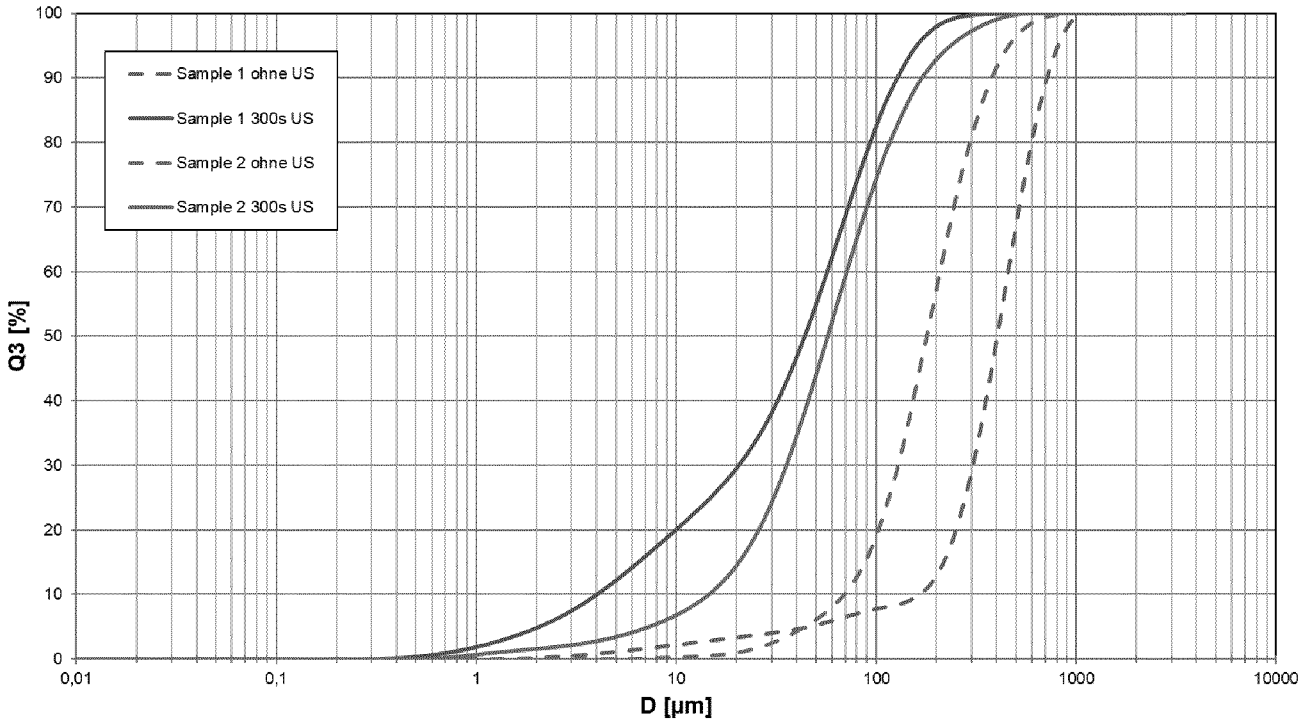


FIG.23

FIG 24A:

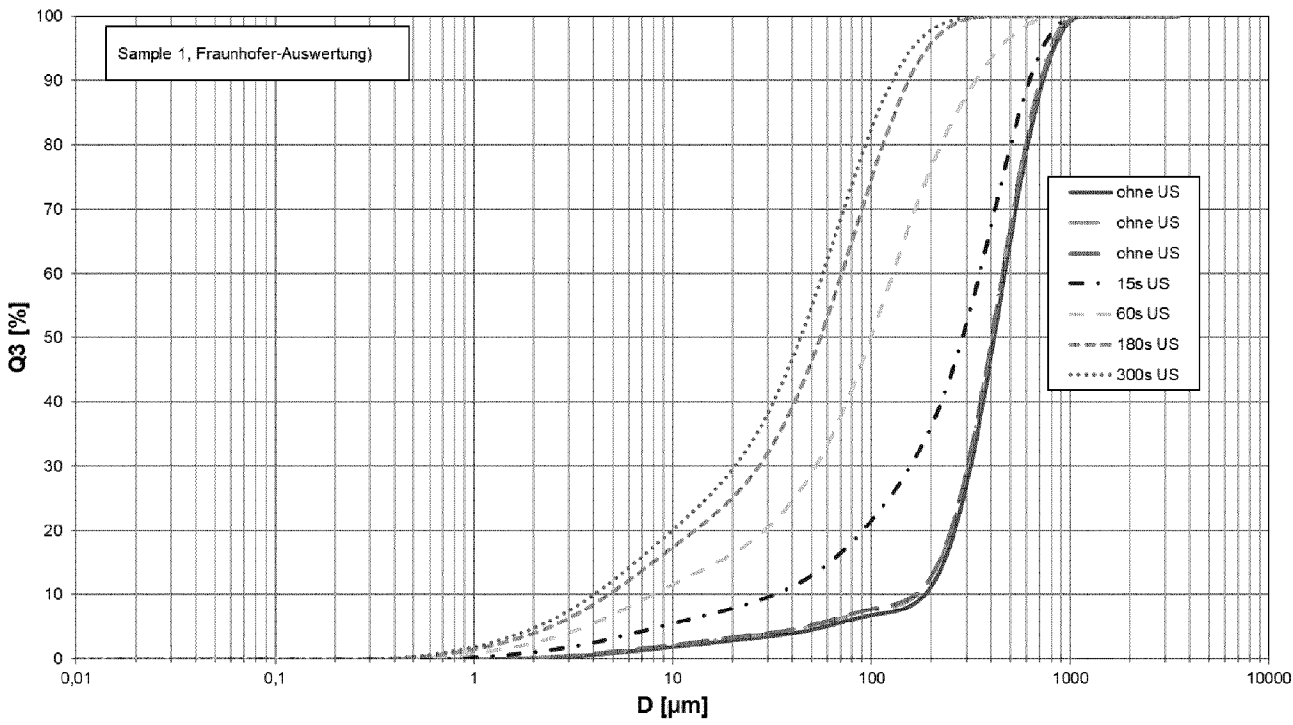


FIG.24A

FIG 24B:

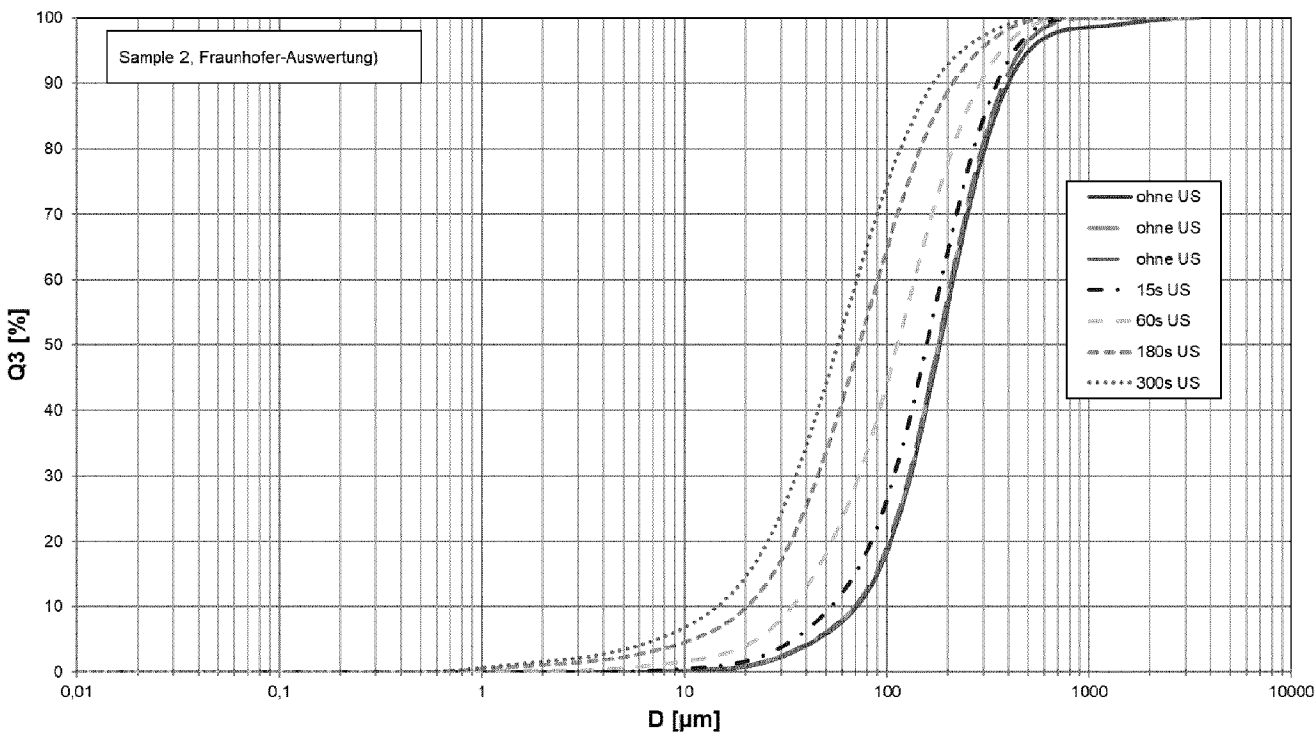


FIG.24B

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2023/065344

A. CLASSIFICATION OF SUBJECT MATTER INV. C07D273/04 ADD.		
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) C07D		
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) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2019/025562 A1 (BAYER AG [DE]; BAYER PHARMA AG [DE] ET AL.) 7 February 2019 (2019-02-07) cited in the application claims 1-22; example 135 -----	1-24
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search		Date of mailing of the international search report
29 June 2023		07/07/2023
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Sáez Díaz, R

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2023/065344

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