



NOTICE OF ALLOWANCE AND FEE(S) DUE

31970 7590 01/27/2010

UNITED STATES DEPARTMENT OF ENERGY
1000 INDEPENDENCE AVENUE, S.W.
ATTN: GC-62 (CHI), MS 6F-067
WASHINGTON, DC 20585-0162

EXAMINER
MANOHARAN, VIRGINIA
ART UNIT PAPER NUMBER
1797
DATE MAILED: 01/27/2010

Table with 5 columns: APPLICATION NO., FILING DATE, FIRST NAMED INVENTOR, ATTORNEY DOCKET NO., CONFIRMATION NO.
Row 1: 11/456,944, 07/12/2006, Milivoje Kostic, S-105,821, 6391
Row 2: TITLE OF INVENTION: ONE-STEP METHOD FOR THE PRODUCTION OF NANOFLUIDS

Table with 7 columns: APPLN. TYPE, SMALL ENTITY, ISSUE FEE DUE, PUBLICATION FEE DUE, PREV. PAID ISSUE FEE, TOTAL FEE(S) DUE, DATE DUE
Row 1: nonprovisional, NO, \$1510, \$0, \$0, \$1510, 04/27/2010

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

- A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.
B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

- A. Pay TOTAL FEE(S) DUE shown above, or
B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

ONE-STEP METHOD FOR THE PRODUCTION OF NANOFLUIDS

Inventors: Milivoje M. Kostic, Mihajlo Golubovic, John R. Hull and Stephen U.S Choi

SUMMARY OF THE INVENTION

In one embodiment of the invention, an improved one-step process and system for manufacture or production of nanofluids includes placing a base fluid, such as ethylene glycol or oil, in a rotating cylindrical drum situated in a vacuum chamber, part of the fluid forming a liquid pool in the bottom part of the drum.

The rotating axis of the drum is preferably horizontal, as a motor rotates the drum at a designated rotational speed. As the drum rotates, it wets and drags liquid filled in the bottom part of the drum along its inside cylindrical surface. At a proper speed a portion of the liquid forms a stream (liquid film) that is transported around the circumference of the inner surface of the drum.

A heater-boat-evaporator (HBE) is positioned in close proximity to the upper inside surface of the cylindrical drum covered by the thin liquid film. The nanoparticle-source, like a metal, evaporates at a given rate and the gaseous atoms and molecules rise away and upwards and forming nanoparticles that deposit onto the liquid film on the surface of the revolving drum forming a nanofluid. The liquid film (now a nanofluid) is further dragged with the drum and mixed with the liquid pool at the bottom of the drum. The liquid is then cooled by a heat exchanger-cooler (HXC) positioned within the liquid pool. In a steady-state process, the cooling capacity of the heat exchanger balances the heat input from the HBE and heat gains from the surroundings. The liquid is subsequently dragged back over the HBE where the cycle is repeated until desired nanoparticle concentration is achieved.

In a preferred form of the invention, the method and system includes: positioning the HBE that evaporates material evaporant close to the moving liquid film in the axial drum direction and with adjustable spacing of the HBE relative to the liquid film, instead of the existing art of fixed position perpendicular to the drum axis. The adjustable spacing of the evaporator is extremely important as it allows one to achieve an adjustable particle deposition path which allows one to control the size of the nanoparticles within the created nanofluid. Generally, decreasing the distance between the HBE and the moving liquid film decreases the size of the nanoparticles incorporated into the nanofluid. This improved process allows that operator control the size of the incorporated nanoparticles in nanofluids and enables one to produce nanofluids with nanoparticles in the wide size range. The invented system allows production of nanofluids with nanoparticles in the size range of about 5-10 nm or less. Previously producing nanofluids incorporating uniform nanoparticle size even in range of 10-30 nm was extremely difficult if not totally unfeasible.

Positioning the HBE in the axial direction is also important as it substantially reduces the amount of time the fluid is subjected to heat radiating and emanating from the HBE. This positioning achieves a smaller fluid-film exposure over the heated source and thus reduces fluid evaporation and its vapor-pressure and in turn the nanoparticle size, but at the same time it provides larger evaporation area and thus larger nanoparticle source evaporation and nanoparticle deposition rate.

The temperature of the liquid can also be controlled by improved liquid cooling by substantially increasing drum rotational speed, improving the design of the heat exchanger that cools the base fluid and nanofluid with liquid nitrogen flow, controlling the cooler-plate-to-drum gap with innovative roller-spacers and adding cooling fins to the cooler-plate or even to the rotating drum if needed.

Additional improvement include a liquid feed-in, inert gas purging and flashing, visual observation, and better process heating control, all of which further contribute to continuous, steady-state operation and control of temperature and pressure for production and optimization of desired nanofluid qualities and quantities.



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OFFICE OF PETITIONS

MILIVOJE KOSTIC
1320 MARRRY WOOD COURT
SYCAMORE, IL 60178-3230

In re Application of	:	
Kostic, et al.	:	
Application No. 11/456,944	:	ON PETITION
Filed: 12 July, 2006	:	
Attorney Docket No. S-105,821	:	

Dear Milivoje Kostic:

You are named as inventor in the above identified United States patent application, filed under the provisions of 35 U.S.C. §116 (United States Code), and 37 C.F.R. §1.47,¹ ¶a, Rules of Practice in Patent Cases. Should a patent be granted on the application you will be designated therein as inventor.

As a named inventor you are entitled to inspect any paper in the file wrapper of the application,

¹ The regulations at 37 C.F.R. §1.47 provide:

§ 1.47 Filing when an inventor refuses to sign or cannot be reached.

(a) If a joint inventor refuses to join in an application for patent or cannot be found or reached after diligent effort, the application may be made by the other inventor on behalf of himself or herself and the nonsigning inventor. The oath or declaration in such an application must be accompanied by a petition including proof of the pertinent facts, the fee set forth in §1.17(h), and the last known address of the nonsigning inventor. The nonsigning inventor may subsequently join in the application by filing an oath or declaration complying with §1.63.

(b) Whenever all of the inventors refuse to execute an application for patent, or cannot be found or reached after diligent effort, a person to whom an inventor has assigned or agreed in writing to assign the invention, or who otherwise shows sufficient proprietary interest in the matter justifying such action, may make application for patent on behalf of and as agent for all the inventors. The oath or declaration in such an application must be accompanied by a petition including proof of the pertinent facts, a showing that such action is necessary to preserve the rights of the parties or to prevent irreparable damage, the fee set forth in §1.17(h), and the last known address of all of the inventors. An inventor may subsequently join in the application by filing an oath or declaration complying with §1.63.

© The Office will send notice of the filing of the application to all inventors who have not joined in the application at the address(es) provided in the petition under this section, and publish notice of the filing of the application in the *Official Gazette*. The Office may dispense with this notice provision in a continuation or divisional application, if notice regarding the filing of the prior application was given to the nonsigning inventor(s).

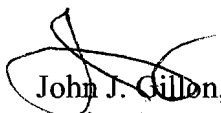
[47 Fed. Reg. 41275, Sept. 17, 1982, effective Oct. 1, 1982; 48 Fed. Reg. 2709, Jan. 20, 1983, effective Feb. 27, 1983; revised, 62 Fed. Reg. 53131, Oct. 10, 1997, effective Dec. 1, 1997; revised, 65 Fed. Reg. 54604, Sept. 8, 2000, effective Nov. 7, 2000]

order copies of all or any part thereof (at a prepaid cost per 37 C.F.R. §1.19) or make your position of record in the application. Alternatively, you may arrange to do any of the preceding through a registered patent attorney or agent presenting written authorization from you. If you care to join the application, counsel of record (see below) would presumably assist you. Joining in the application would entail the filing of an appropriate oath or declaration by you pursuant to 37 C.F.R. §1.63.

Requests for information regarding your application should be directed to the File Information Unit at (703) 308-2733.

Information regarding how to pay for and order a copy of the application, or a specific paper in the application, should be directed to Certification Division at (703) 308-9726 or toll-free: (800) 972-6382 (outside the Washington D.C. area).

While telephone inquiries regarding this decision may be directed to the undersigned at (571) 272-3214, it is noted that all practice before the Office is in writing (see: 37 C.F.R. §1.2²) and the proper authority for action on any matter in this regard are the statutes (35 U.S.C.), regulations (37 C.F.R.) and the commentary on policy (MPEP). Therefore, no telephone discussion may be controlling or considered authority for Petitioner's/Caller's action(s).



John J. Gillon, Jr.
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² The regulations at 37 C.F.R. §1.2 provide:

§1.2 Business to be transacted in writing.

All business with the Patent and Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.