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An Overview on Applications of Nanofluids

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ABSTRACT: Processing and producing materials with average size in the range of 100nm is being made possible by the modern nanotechnology. Nanometre-sized particles suspended in base fluids forming colloidal solutions are called nanofluids. Nanofluids show significant enhancement of their properties at modest nanoparticle concentrations. Nanofluids have novel properties that are making them the next generation heat transfer fluids because they are opening new possibilities that are making them next generation heat transfer fluids. Nanofluids are typically made of metals, oxides, carbides or carbon nanotubes in a base fluids like water, oil and ethylene glycol. Straight heat transfer enhancement is an important factor in many industries, nuclear reactors, engine cooling systems of automotives, refrigeration, space technology, defence, microelectronics, fuel cells etc. Nanofluids are acting as smart fluids in situations where heat transfer has to be reduced or enhanced as desired i.e., acting like a heat valve.

KEYWORDS: Nanofluids, Nuclear reactors, Cancer therapeutics

I. INTRODUCTION

Nanofluids are dilute liquid suspensions of nanoparticles with atleast one of their principal dimensions smaller than 100nm. From the previous investigations, Nanofluids have been found to possess enhanced thermo physical properties such as thermal conductivity, thermal diffusivity, viscosity and convective heat transfer coefficients compared to those of base fluids like water, oil and ethylene glycol. Nanofluids clearly exhibit enhanced thermal conductivity which goes up with increasing volumetric fraction of nanoparticles.

II. APPLICATIONS OF NANOFUIDS

Nanofluids can be used in broad range of engineering applications due to their improved heat transfer and energy efficiency in a variety of thermal systems. The following section gives a brief idea of different areas of nanofluids applications based on the literatures.

I. AUTOMOTIVE APPLICATIONS: Engine oils, automatic transmission fluids, coolants, lubricants and other synthetic high temperature heat transfer fluids found in conventional truck thermal systems-radiators, engines, heating, ventilation and air-conditioning-have inherently poor heat transfer properties. These could benefit from the high thermal conductivity offered by nanofluids that resulted from addition of nanoparticles. Nanofluids as coolant: the use of nanofluids as coolants would allow for smaller size and better positioning of the radiators. Owing to the fact that there would be less fluid due to the higher efficiency, coolant pumps could be shrunk and truck engines could be operated at higher temperature allowing for more horsepower. Argonne researchers, Singh et al, have determined that the use of high-thermal conductive nanofluids in radiators can lead to the reduction in the frontal area of the radiators by up to 10. This Reduction in aerodynamic drag can lead to a fuel savings of up to 5. The application of nanofluids also contributed to a reduction of friction and wear, reduction parasitic losses, operation of components such as pumps and compressors, and subsequently leading to more than 6 fuel savings. Nanofluids in Fuel: The combustion of diesel fuel mixed with aqueous aluminium Nanofluids increased the total combustion heat while decreasing the concentration of smoke and nitrous oxide in the exhaust emission from the diesel engine. It is due to the high oxidation activity of pure Al which allows for increased decomposition of hydrogen from water during the combustion process. Nanofluids in Brake Fluids: During the process of braking, the produced heat causes the brake fluid to reach its boiling point, a vapour lock is created that retards the hydraulic system from dispersing the heat caused from braking. It will create a brake malfunction and poses a safety hazard in vehicles. Nanofluids with enhanced characteristics maximize performance in heat transfer as well as remove any safety concerns.

II. Smart fluids: Nanofluids enable us to handle our energy resources efficiently and thus can act as smart fluids. It has been recently shown that Nanofluids can be used as smart heat valve to control the flow of heat. Nanofluids can be configured into a low -state, where it conducts heat poorly, can also be configured into a high- state, where it conducts heat efficiently. This enable the use of Nanofluids as Smart fluid in cooling.

III. Nuclear reactors: The use of Nanofluids as coolant in Nuclear reactors is a very promising application because Nanofluids can be highly effective in cooling over heated surfaces in an emergency situation. There are a few concerns regarding the loss of nanoparticles through the boiling vapour and regarding the safety measures for the disposal of nanofluid. Despite the concerns that we have, application of Nanofluids in Nuclear reactors is a very promising future application.

IV. Electronic Applications: Nanofluids are used for cooling of microchips in computers and elsewhere. They are also used in other electronic applications which use microfluidic applications. Nanofluids can be greatly effective in the cooling of microchips. The high thermal conductivity of nanofluid enable them to cool microchips very quickly. Nanofluids can be used to control micro fluidic systems and can be engineered to control the wettability of a surface and its surface tension. Droplets of nanofluids have contact angles which can be varied and this can be applied to the moving of liquids in micro systems. The variability of the contact angle of Nanofluids could provide us with novel methods for focusing lenses in small cameras and for cooling of micro computer chips. Microscale Fluidic Applications. The manipulation of small volumes of liquid is necessary in fluidic digital display devices, optical devices, and microelectromechanical systems (MEMS) such as lab-on-chip analysis systems. This can be done by electro wetting, or reducing the contact angle by an applied voltage, the small volumes of liquid. Electro wetting on dielectric (EWOD) actuation is one very useful method of micro scale liquid manipulation.

V. Biomedical Applications: Nano drug Delivery. Most bio-MEMS studies were done in academia in the 1990s, while recently commercialization of such devices have started. Examples include an electronically activated drug delivery microchip; a controlled delivery system via integration of silicon and electro active polymer technologies; MEMS-based DNA sequencer developed by Cepheid; and arrays of in-plane and out-of plane hollow micro-needles for dermal transdermal drug delivery as well as Nano medicine applications of Nano gels or gold-coated nanoparticles. An objective of the advanced endeavours in developing integrated micro or nano-drug delivery systems is the interest in easily monitoring and controlling target-cell responses to pharmaceutical stimuli, to understand biological cell activities, or to enable drug development processes.

Cancer therapeutics. There is a new initiative which takes advantage of several properties of certain nanofluids to use in cancer imaging and drug delivery. This initiative involves the use of iron-based nanoparticles as delivery vehicles for drugs or radiation in cancer patients. It will allow doctors to deliver high local doses of drugs or radiation without damaging nearby healthy tissue, which is significant side effect of traditional cancer treatment methods. In addition, magnetic nanoparticles are more adhesive to tumour cells than micro particle in alternating current magnetic fields tolerable in humans they makes excellent candidates for cancer therapy.

Nano cryosurgery. Cryosurgery is a procedure that uses freezing to destroy undesired tissues. This therapy is becoming popular because of its important clinical advantages. Although it still cannot be regarded as a routine method of cancer treatment, cryosurgery is quickly becoming as an alternative to traditional therapies. Simulations were performed by Yan and liu on the combined phase change bioheat transfer problems in a single cell level and its surrounding tissues, to explicate the difference of transient temperature response between conventional cryosurgery and nanocryosurgery. According to theoretical interpretation and existing experimental measurements intentional loading of nanoparticles with high thermal conductivity into the target tissues can reduce the final temperature, increase the maximum freezing rate, and enlarge the ice volume obtained in the absence of nanoparticles Additionally, introduction of nanoparticle enhanced freezing could also make conventional cryosurgery more flexible in many aspects such as artificially interfering in the size, shape, image and direction of iceball formation. The concepts of nanocryosurgery may offer new opportunities for future tumour treatment.

Proteins and Peptide Delivery Protein and peptides are macromolecules and are called biopharmaceuticals. These have been identified for treatment of various diseases and disorders as they exert multiple biological actions in human body.

Nano materials like nano particles and dendrimers are called as nano biopharmaceuticals, are used for targeted and/or controlled delivery.

III.CONCLUSION

Nanofluids are important because they can be used in various applications involving heat transfer. Colloids which are also nanofluids have been used in the biomedical field for a long time, and their use will continue to grow. Nanofluids employed in experimental research have to be well characterized with respect to particle size, sizedistribution, shape and clustering so as to render the results most widely applicable.

Further research still has to be done on the synthesis and applications of nanofluids so that they may be applied as predicted.

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