

BIOEN 509 – DEPARTMENTAL SEMINAR SERIES

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Foege Bioengineering Building N130A

Nanoduct Fluid Flow

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Abstract: Nanofluid duct flow refers to regions of intense vorticity in a flowing fluid in a duct less than 100 nanometers in width. In the shear layers at the fluid/wall interface it is shown, based on molecular kinetic theory and thermodynamics, that the macroscopic rotation must be accompanied by internal rotation of the molecules. It is also shown that electric polarization of the internal of the internal molecular rotations about the local rotation axis –the Barnett effect- occurs. In such a spin-aligned system, changes in the physical properties of the fluid result; heat conduction and optical properties are taken as examples. References to published experimental data are given, which support these changes. Such major changes in the fluid physical properties is a feature of nanoscale physics. Thermal energy transport is by wave motion rather than by molecular collisions. There is a distinctive phase transition at the nanoscale from the macroscopic scale at the upper limit to the molecular scale at the lower limit. Recognition of the existence of nanoscale fluid physics affords the possibility of new methods of fluid flow control.

Dr. Percival D. McCormack, M.D., Ph.D. is a Professor of Bioengineering, Biophysics and Physiology at the University of Illinois at Chicago. He received the M.D. degree in 1978 from Trinity College, Dublin, Ireland and prior to that obtained a Ph.D. in nuclear physics. From 1979 to 2000 he was a US Navy doctor and flight surgeon and for 6 years was assigned to NASA as Chief of Operational Medicine. He also served for 6 years as Chief of Environmental Medicine at the Navy Medical Research Institute, Bethesda, Maryland. In 2000 he took up his present post at the University of Illinois at Chicago. He works on imaging techniques such as ultrasound and MRI. Nanofluids is a topic of special interest for him and he is writing a textbook on “The Vortex, Molecular Spin and Nanovorticity” for Springer-Verlag. He has been a Fellow of the American Association of Aerospace Medicine for many years and recently was appointed to the Advisory Council for the National Institute of Biomedical Imaging and Bioengineering (NIBIB).

