Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Deformation and Magnetophoresis of Bubbles in Magnetic Fluids (Ferrofluids) PHILIP YECKO, Montclair State University, WAH-KEAT LEE, Argonne National Laboratory, RUBEN SCARDOVELLI, Universita di Bologna, A. DAVID TRUBATCH, Montclair State University — The deformation and coalescence of small bubbles in magnetic fluid (ferrofluid) are directly observed and measured using a novel X-ray phase contrast imaging technique. High resolution X-ray images and videos of water-based ferrofluid (EMG-607/707) reveal: (i) vapor bubbles having diameters in the range 50 to 1000 microns form readily, (ii) neighboring bubbles chain together readily, but do not merge, and (iii) the dynamics of interfaces (bubbles) in ferrofluids are modified by the presence of long chain-like aggregates of the constituent magnetic nanoparticles. Isolated bubbles larger than a few hundred microns become visibly prolate in an applied field, elongating along the field direction. The observed deformations compare favorably with theoretical estimates and the results of direct numerical simulations (DNS). Coalescence is driven by attractive magnetophoretic force induced by non-uniform fields associated with individual bubbles, as was verified by comparing coalescence dynamics to theoretical prediction and to detailed results from DNS. Chain like aggregates of magnetic nanoparticles aligned with the applied field were ubiquitous and led to anisotropic field dependent drag effects. A multiple color function Volume of Fluid (VOF) technique was used to suppress bubble merger in DNS.

Philip Yecko
Montclair State University

Date submitted: 07 Aug 2009 Electronic form version 1.4