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Bubble chains in magnetic fluids PHILIP YECKO, Montclair State University, WAH-KEAT LEE, Argonne National Laboratory — Interactions between small numbers of bubbles of non-magnetic fluid immersed in a magnetic fluid (ferrofluid) are examined by direct numerical simulation using a volume of fluid (VOF) interface capturing method coupled to a magneto-quasistatic Maxwell solution. Constant magnetic susceptibility (linear magnetic material) is assumed and the Reynolds number is small, but does not vanish. For small gravitational and magnetic Bond numbers, the dynamics of multiple bubbles is controlled by the dipole fields induced by the bubbles, which for certain initial configurations leads naturally to the formation of linear chains of nearly spherical bubbles. The study of bubble chains using a VOF approach is facilitated by introducing multiple VOF phase functions, surpressing merger of bubbles. At larger Magnetic Bond numbers, the bubbles also elongate in the direction of the magnetic field, altering the coalescence process. Model results are shown to be in agreement with experiments performed using high resolution X-ray images of air bubbles in ferrofluid. The complementary problem of magnetic fluid droplets is also examined for its utility as a possible model for the microstructure of ferrofluids that can be used to predict their rheological properties, in particular the competition between shear and chain structures.

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