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Generation of dynamic self-propelled structures by symmetry breaking mechanism in driven magnetic layers on the surface of liquid ALEXEY SNEZHKO, MAXIM BELKIN, IGOR ARANSON, Argonne National Laboratory — Magnetic particles suspended over the surface of a liquid and energized by a vertical alternating magnetic field give rise to remarkable dynamic multi-segment magnetic structures ("snakes"). These structures (dynamic by nature) are directly related to surface waves in the liquid generated by the collective response of magnetic microparticles to the alternating magnetic field. The self-assembly process and existence of the magnetic snakes is accompanied by a generation of strong surface flows in the liquid. Properties of the snake and corresponding surface flows could be tuned by the parameters of the external magnetic driving. We demonstrate that above some critical frequency threshold magnetic snakes lose their stability and start to swim in the container. The effect is attributed to the development of symmetry breaking instability of the structure with respect to self-generated surface flows in the liquid. Parameters of the driving magnetic field are effectively used to control rich behavior of the dynamic magnetic swimmers.

Alexey Snezhko
Argonne National Laboratory

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