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Guiding catalytically active particles with chemically patterned surfaces WILLIAM USPAL, MIHAIL POPESCU, SIEGFRIED DIETRICH, MYKOLA TASINKEVYCH, Max-Planck-Institut für Intelligente Systeme and IV. Institut für Theoretische Physik, Universität Stuttgart — Catalytically active Janus particles in solution create gradients in the chemical composition of the solution along their surfaces, as well as along any nearby container walls. The former leads to self-phoresis, while the latter gives rise to chemi-osmosis, providing an additional contribution to self-motility. Chemi-osmosis strongly depends on the molecular interactions between the diffusing chemical species and the wall. We show analytically, using an approximate "point-particle" approach, that by chemically patterning a planar substrate (e.g., by adsorbing two different materials) one can direct the motion of Janus particles: the induced chemi-osmotic flows can cause particles to either "dock" at a chemical step between the two materials, or to follow a chemical stripe. These theoretical predictions are confirmed by full numerical calculations. Generically, docking occurs for particles which tend to move away from their catalytic caps, while stripe-following occurs in the opposite case. Our analysis reveals the physical mechanisms governing this behavior.

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