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Colloidal transport and diffusion over a tilted periodic energy landscape[1] XIAOGUANG MA, Hong Kong University of Science and Technology, PIK-YIN LAI, National Central University, Taiwan, BRUCE ACKERSON, Oklahoma State University, PENGER TONG, Hong Kong University of Science and Technology — A tilted two-layer colloidal system is constructed to study force-assisted barrier-crossing dynamics over a periodic energy landscape. The energy landscape is provided by the bottom layer colloidal spheres forming a fixed crystalline pattern on a glass substrate. The corrugated surface of the bottom colloidal crystal provides a gravitational potential field for the top layer diffusing particles. By tilting the sample at an angle with respect to the direction of gravity, a tangential component of the gravitational force F is applied to the diffusing particles. The measured mean drift velocity v(F,E) and diffusion coefficient D(F,E) of the particles as a function of F and energy barrier height E agree well with the exact solution of the one-dimensional Langevin equation. From the exact solution we show analytically and verify experimentally that there exists a scaling region, in which v and D both scale as a(F)exp[-E*(F)/k_BT], where the Arrhenius pre-factor a(F) and effective barrier height E*(F) are both modified by F. The experiment demonstrates the applications of this model system in evaluating different scaling forms of a(F) and E*(F) and their accuracy, in order to extract useful energetic information.

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