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Theory of semiconductor nanoplatelet growth: How an intrinsic growth instability leads to highly anisotropic, quasi-two-dimensional platelets STEVE ERWIN, Naval Research Lab, ANDREAS RIEDINGER, FLORIAN OTT, ANIKET MULE, SERGIO MAZZOTTI, PHILIPPE KNUESEL, STEPHAN KRESS, FERRY PRINS, DAVID NORRIS, ETH Zurich — Colloidal nanoplatelets are atomically flat, quasi-two-dimensional sheets of semiconductor that can exhibit efficient, spectrally pure fluorescence. Despite intense interest in their properties, the mechanism behind their highly anisotropic shape and precise atomic-scale thickness remains unclear, and even counterintuitive for commonly studied nanoplatelets that arise from isotropic crystal structures (e.g. zincblende CdSe and lead-halide perovskites). We show theoretically that an intrinsic instability in growth kinetics leads to such highly anisotropic shapes. By combining experimental results on the synthesis of CdSe nanoplatelets with theory predicting enhanced growth on narrow surface facets, we develop a model that explains nanoplatelet formation as well as observed dependencies on time and temperature. Based on standard concepts of volume, surface, and edge energies, the resulting growth instability criterion can be directly applied to other crystalline materials.

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