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**Black Silicon Formation in Cryogenic Reactive Ion Etching** DAVID ABI SAAB, PHILIPPE BASSET, Universite Paris Est, ESIEE Paris, ESYCOM, MATTHEW J. PIEROTTI, MATTHEW L. TRAWICK, University of Richmond, DAN E. ANGELESCU, Universite Paris Est, ESIEE Paris, ESYCOM — We present both experimental data and computational modeling that explain some aspects of the formation of black silicon during cryogenic reactive ion etching (RIE) processes. We generate a phase diagram that predicts combinations of RIE parameters that lead to different black silicon geometries. We also show that the combination of needle- and hole-like features of various heights and depths in black silicon creates a uniquely smooth transition in refractive index that is responsible for the material's low optical reflectivity. These details are captured by our model and confirmed by focused ion beam (FIB) nanotomography and scanning electron microscopy of black silicon surfaces during various stages of development. The model also correctly describes dynamical characteristics such as the dependence of aspect ratio on process time, and the prediction of new etching fronts appearing at topographical saddle points.

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