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Tuning the density and structure of amorphous Si thin films via growth parameters[1] HILARY JACKS, MANEL MOLINA-RUIZ, DAVID CASTELLS-GRAELLS, ALEJANDRO CEBALLOS, FRANCES HELLMAN, Department of Physics, University of California Berkeley, Berkeley, CA 94720 — The atomic density of electron beam evaporated amorphous silicon (a-Si) thin films is here shown to depend strongly upon deposition temperature, growth rate, and total film thickness. Previous work has shown that the density of two-level systems (TLS) – a defect of interest in amorphous materials – are tunable and inversely correlated with atomic density. Densities and structural qualities are measured via RBS, AFM, and Raman spectroscopy. We show that density increases steadily with growth temperatures up to 425 C, with anomalous behavior at higher temperatures suggesting the nucleation of a different type of structure. Density also depends on growth rate; higher growth rates result in films with lower densities. Film density increases as the total thickness of a film is increased from 10 to 600 nm; additionally, and significantly, no gradient is observed in these films, which indicates that underlying film structure changes after subsequent layers are deposited. We describe physical processes to account for these trends, and implications to both the amorphous materials community and technologies that utilize these materials.

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