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Optimizing Epitaxial Cu and Ni Films on Al_2O_3(0001) for Uniform Graphene Growth DAVID L. MILLER, MARK W. KELLER, ROBERT R. KELLER, JUSTIN M. SHAW, ANN N. CHIARAMONTI, National Institute of Standards and Technology, Boulder, CO — Copper and nickel are the most commonly used substrates for the growth of graphene by chemical vapor deposition. While cold-rolled polycrystalline foils are most often selected for their commercial availability and ability to withstand the high temperatures required for graphene growth, (111) crystal faces have been shown to offer better growth characteristics on both materials. We deposited Cu and Ni films onto single crystal Al_2O_3(0001) using magnetron sputtering at temperatures between 250°C and 700°C. This gave films with pure (111) texture but with two epitaxial in-plane orientations as measured by x-ray diffraction and electron backscatter diffraction. Upon heating to graphene CVD temperatures (900°C to 1000°C), the grain boundaries widen and deepen into trenches that prevent the growth of uniform graphene over large areas. Reactive sputtering of a thin layer of Al_2O_3 before depositing the metal results in a single in-plane orientation over $> 90\%$ of the film for Ni. In addition, gradually increasing the temperature during metal deposition suppresses the formation of deep trenches under graphene CVD conditions. We compare CVD graphene grown on the optimized films with that grown on commercial foils.

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