Lowering the electron emission threshold in diamond using negative electron affinity lithium-oxygen termination

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Low threshold electron emission from diamond depends on a low workfunction. This can be achieved either by introducing a shallow donor state into the bulk or by changing the surface termination. In addition to lowering the workfunction, certain surface treatments induce a negative electron affinity, where the conduction band minimum lies above the vacuum level. Lithium has been found by this project to play a significant role as an adsorbate on the oxygenated diamond surface. When an oxygenated C(100) or C(111) diamond surface is covered with a single monolayer of lithium, computational studies have predicted a strongly bound surface layer that gives the surface a very strong negative electron affinity. This talk will discuss the theoretical predictions, as well as presenting experimental evidence of such a surface. X-ray and ultraviolet photoemission studies of boron-doped and phosphorus doped diamond with an Li-O surface layer indicate an NEA of -2.1eV and a workfunction of 2.8 eV, compared to the theoretical predictions of -3.9eV and 1.48eV respectively, with the difference likely coming from a mixed surface coverage. This surface layer is stable in air and remains present on the diamond surface at temperatures above 1000 degrees celsius in vacuum. This surface has a theoretically higher NEA than other stable constructions on the diamond surface such as hydrogen termination and is more stable than other NEA terminations such as cesium oxide. As a result, the Li-O surface termination on diamond is a very promising material to produce a low workfunction diamond surface for electron emission.