The use of rare-earth monosulfides to realize low or negative electron affinity cold cathodes

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Over the last 30 years, various cold cathodes have been proposed based on the concept of negative electron affinity (NEA) [1]. In this poster, we analyze the use of two sulfides of rare-earth elements (LaS and NdS) to develope highly stable NEA surfaces. These materials have a rocksalt structure compatible with the structure of traditional semiconductors. These compounds are chemically reasonably stable and do not suffer from the limitations of caesiated surfaces. Of particular interest is the fact that the work function at room temperature of these compounds, when extrapolated from high-temperature measurements [2], are quite small. It is therefore expected that these materials can be used to reach NEA when deposited on *p*-type doped semiconductors. For instance, LaS has a lattice constant (5.854 A) very close to the lattice constant of InP (5.8688 Angstroms) and NdS has a lattice constant (5.69 Angstroms) very close to the lattice constant of GaAs (5.6533 Angstroms). Since the room temperature work function of LaS (1.14 eV) and NdS (1.36 eV) are respectively below the band gap of InP (1.35 eV) and GaAs (1.41 eV), NEA can therefore be reached at InP/LaS and GaAs/NdS interfaces using heavily *p*-type doped semiconductors.

We will report our most recent theoretical investigations of space-charge effects in the vacuum region and the associated noise reduction in the anode current density for a InP/CdS/LaS cold cathode [3]. We will also report some of the experimental progress towards the realization of this cathode. We will describe the successful growth of bulk samples of LaS and NdS using the sesquisulfide route and their characterization using X-ray and Raman scattering. We will also report the measured values of the work function of LaS and NdS using a Kelvin probe technique.

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