Determination of the electronic state of Er in sputtered AlN:Er films by magnetic measurements

V. NARANG, M.S. SEEHRA, Department of Physics and Astronomy, West Virginia University, Morgantown, WV, 26506, USA, D. KORAKAKIS, Lane Department of Computer Science and Electrical Engineering, West Virginia University, Morgantown, WV, 26506, USA — The optoelectronic [1] and piezoelectric [2] properties of AlN:Er thin films for device applications have been of great recent interest. The magnitude of optical activity depends on local crystalline environments of Er [3]. Here we focus on the electronic state of Er in AlN:Er (1.6 at.%) films prepared by reactive magnetron sputtering on Si substrate. X-ray diffraction of the films shows that Er doping expands the lattice and XPS studies confirm the presence of Er. To determine if Er is present as Er metal, Er$_2$O$_3$ or Er$^{3+}$ substituting for Al$^{3+}$, magnetization was measured vs. temperature (2 K to 300 K) in $H = 1kOe$ and data is found to fit the Curie law with a magnetic moment $\mu = 4.85 \mu_B$ per Er, in good agreement with expected value for Er$^{3+}$ substituting for Al$^{3+}$ in AlN [4]. The presence of Er$_2$O$_3$ and Er metal is ruled out since magnetic transitions expected for Er$_2$O$_3$ (Er metal) at 3.4 K ($\sim$30 K) are not observed, thus establishing that Er substitutes for Al as Er$^{3+}$ in the AlN:Er films.


Vishal Narang
West Virginia University

Date submitted: 14 Nov 2013