# Transition-metal-doped lithium aluminates for neutron scintillation

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Neutron radiation and neutron detection systems have become of great importance recently, as the number of their applications in research, medical, security and other advanced fields have been gradually growing. Scintillators for thermal neutrons utilize a nuclear reaction of isotopes with a high cross section for neutron capture, such as $^{6}$Li or $^{10}$B. The resulting nuclear reaction creates high-energy charged particles that produce scintillating light along their ionization tracks. Important requirements for neutron scintillators are low density and effective atomic number, which are necessary to minimize their sensitivity to high-energy photons ( $\gamma$-ray background). Promising host materials with high lithium content, low density and atomic number are oxides within the binary $Li_2O$-$Al_2O_3$ system. Depending on the $Li_2O$ content, these can be distinguished as the lithium-rich $Li_5AlO_4$, the intermediate $LiAlO_2$ and the aluminum-rich $LiAl_5O_8$.

In this work, a complementary study of the lithium aluminates $LiAlO_2$, $LiAl_5O_8$ and $Li_5AlO_4$ doped with transition metal ions $Cu^{+}$ and $Ti^{3+}$ is presented. Bulk ceramic samples of tetragonal $\gamma$-$LiAlO_2$ and cubic $\alpha$-$LiAl_5O_8$ with varying doping concentrations were prepared using the Pechini sol-gel method. Luminescence characterization of the samples was performed using X-ray-excited radioluminescence, photoluminescence excitation and emission spectra, and luminescence decay measurements. Samples of undoped and Cu-doped $Li_5AlO_4$ were prepared by solid state synthesis based on thermal decomposition of metal nitrates. These samples exhibited strong hygroscopic properties, which makes $Li_5AlO_4$ an unsuitable host material outside a controlled atmosphere environment.

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