Supplementary Information

Cross-sectional transmission electron microscopy and energy-dispersive X-ray spectroscopy of the $Al_xNi_{1-x}O$ film.

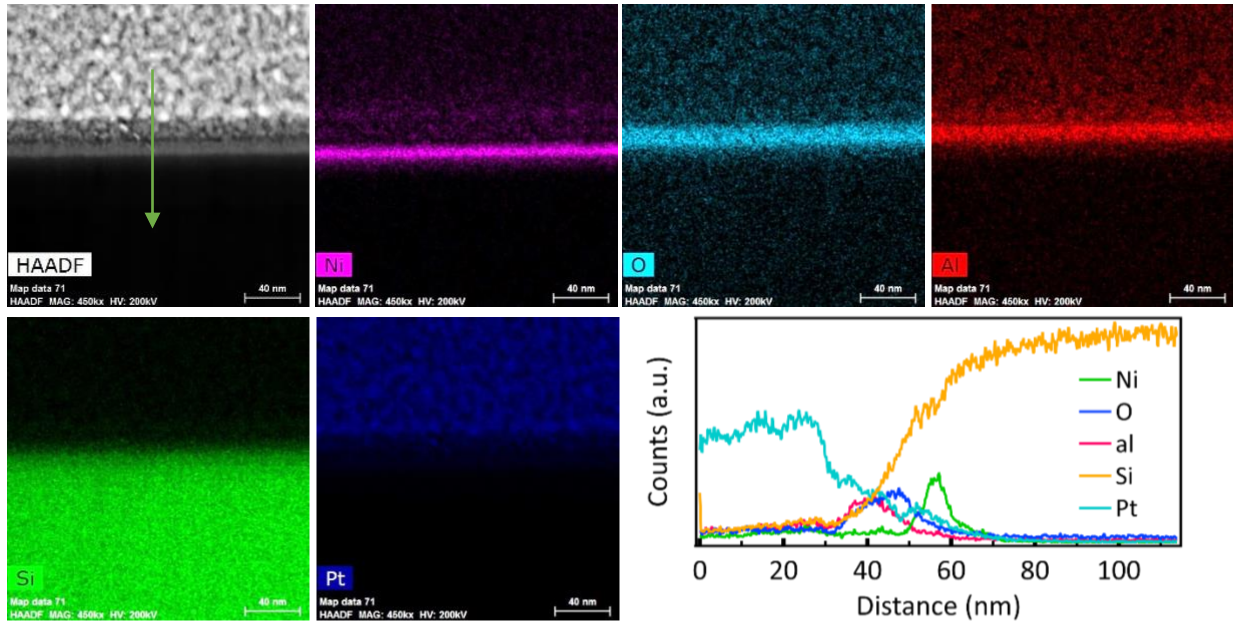

Figure 1. Cross-sectional TEM and EDS mapping images show the Ni, O, Al, Si and Pt, and the corresponding EDS elemental line scan of the c-Si/SiO_x/$Al_xNi_{1-x}O$ film.

Contact performance of the $Al_xNi_{1-x}O$ film with p-type crystalline silicon

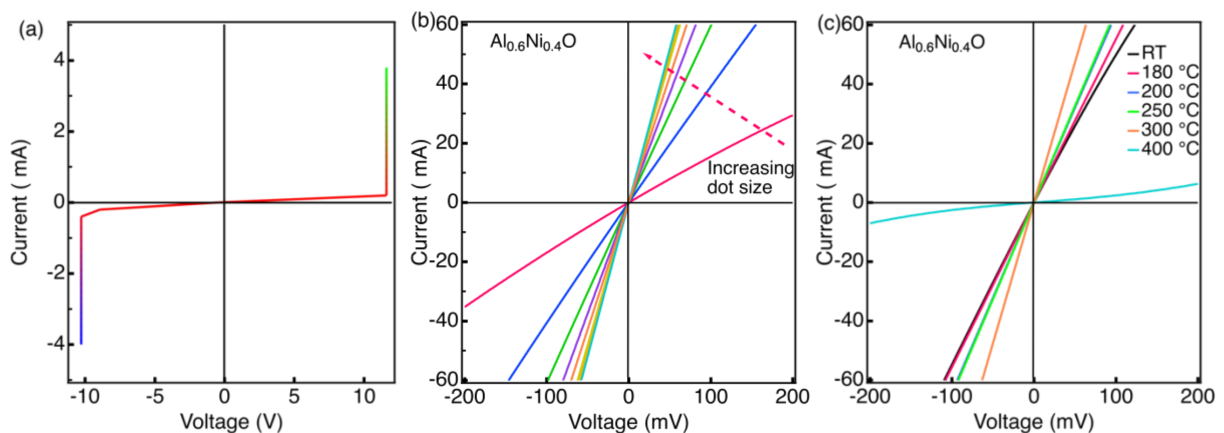

Figure 2. *I-V* characteristics of (a) a undoped NiO film, (b) as-deposited $Al_xNi_{1-x}O$ film measured in the Cox and Strack structure with an increasing dot size, and (c) post-treated film with annealing temperatures of 180 – 300 °C show improved contact performance compared to the as-deposited film, however, the contact performance reduced upon annealing at 400 °C.