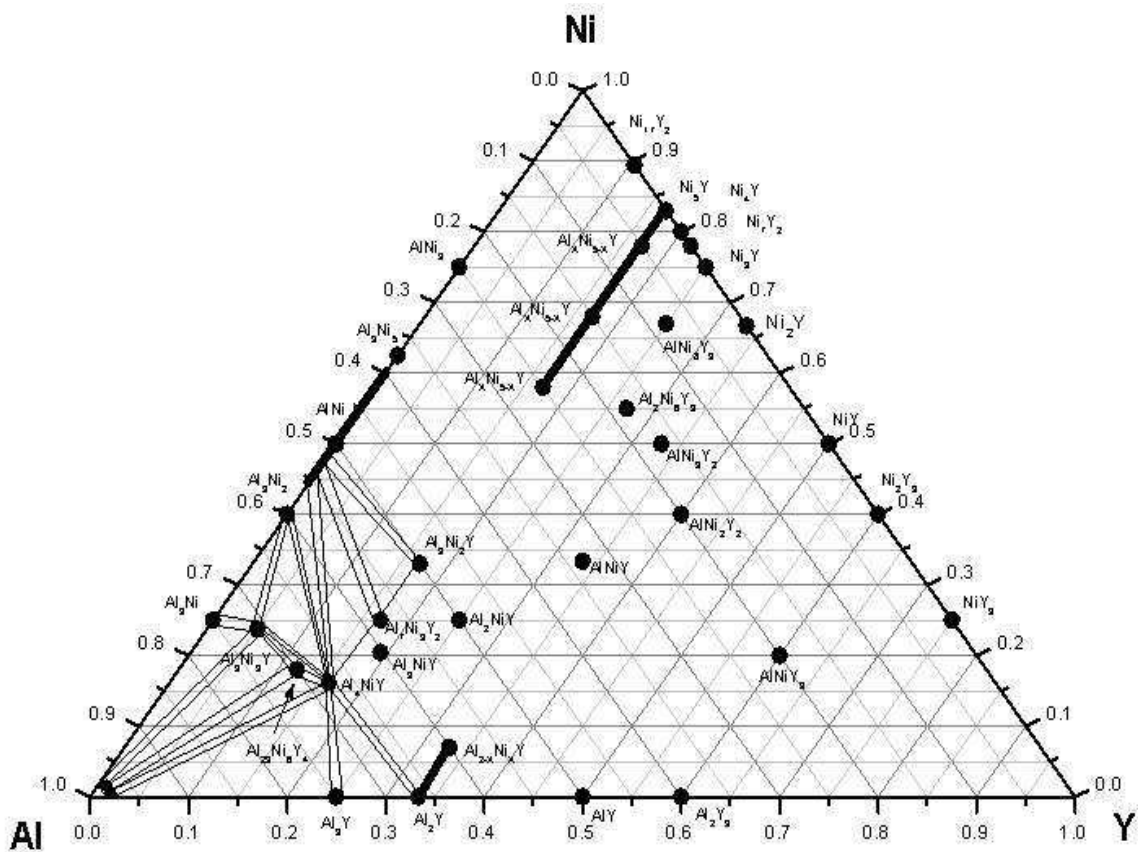


Enthalpies of formation of intermetallic compounds and phase equilibria in Al-Ni-X (X=Y, Hf, Fe) alloy systems.

Hsin-Ning Su and Philip Nash  
 Thermal Processing Technology Center, IIT  
 10 W 32<sup>nd</sup> St., Chicago, IL 60616, USA

The enthalpies of formation of intermetallic compounds in the ternary systems Al-Ni-X (X=Y, Hf, Fe) have been determined by high temperature direct synthesis calorimetry. These alloy systems are of importance for structural applications and some compositions can produce metallic glass. For phases exhibiting extensive solid solubility the enthalpy of formation has been measured as a function of composition. The enthalpy values measured are compared to previously published results, where available, and to extended Miedema model predictions, Table 1. Confirmation of the product phases is made using x-ray diffraction. Differential thermal analysis has been used to determine phase transition temperatures of several of the compounds. X-ray diffraction, metallography and energy dispersive x-ray analysis have been used to verify the phase equilibria in these systems and in some cases revisions to the phase equilibria have been made. The Al-Ni-Y phase diagram had not previously been fully established and so we have determined a partial isothermal section of the Al-Ni-Y phase diagram at 650°C, Figure 1.

Compound	Experimental $\Delta H_{\text{formation}}$ <sup>a</sup> kJ/mole	$\Delta H_{\text{formation}}$ Miedema's model kJ/mole
Al <sub>7</sub> Ni <sub>3</sub> Y <sub>2</sub>	-61.3±1.0	-47.2
Al <sub>3</sub> NiY	-59.8±1.8	-49.0
Al <sub>9</sub> Ni <sub>3</sub> Y	-47.0±2.0	-36.2
Al <sub>23</sub> Ni <sub>6</sub> Y <sub>4</sub>	-50.6±1.8	-38.7
Al <sub>4</sub> NiY	-54.5±1.2	-44.1
AlNi <sub>2</sub> Hf	-58.2±1.7	-55.4
Al <sub>3</sub> Ni <sub>5</sub> Hf <sub>2</sub>	-60.3±1.3	-52.7
Al <sub>4</sub> Ni <sub>75</sub> Hf <sub>21</sub>	-44.4±1.1	-42.6
Al <sub>8</sub> Ni <sub>71.5</sub> Hf <sub>20.5</sub>	-47.6±1.4	-44.1
Al <sub>13</sub> Ni <sub>67</sub> Hf <sub>20</sub>	-50.5±1.2	-45.9
Al <sub>19</sub> Ni <sub>75</sub> Hf <sub>6</sub>	-39.6±1.3	-33.1
Al <sub>23</sub> Ni <sub>75</sub> Hf <sub>2</sub>	-37.8±1.1	-35.7
Al <sub>26</sub> Ni <sub>54</sub> Hf <sub>20</sub>	-56.3±1.4	-51.5
Al <sub>26</sub> Ni <sub>50</sub> Hf <sub>24</sub>	-61.0±1.2	-54.0
AlNiFe	-39.4±1.3	-29.3
Al <sub>2</sub> NiFe	-44.5±0.9	-31.4
AlNiFe <sub>2</sub>	-27.9±1.4	-22.5
Al <sub>9</sub> NiFe	-25.8±1.4	-15.8



Partial isothermal section of Al-Ni-Y system at 650 °C