Ti(Ni,Cu) pseudobinary compounds: efficient negative electrodes for Ni-MH batteries

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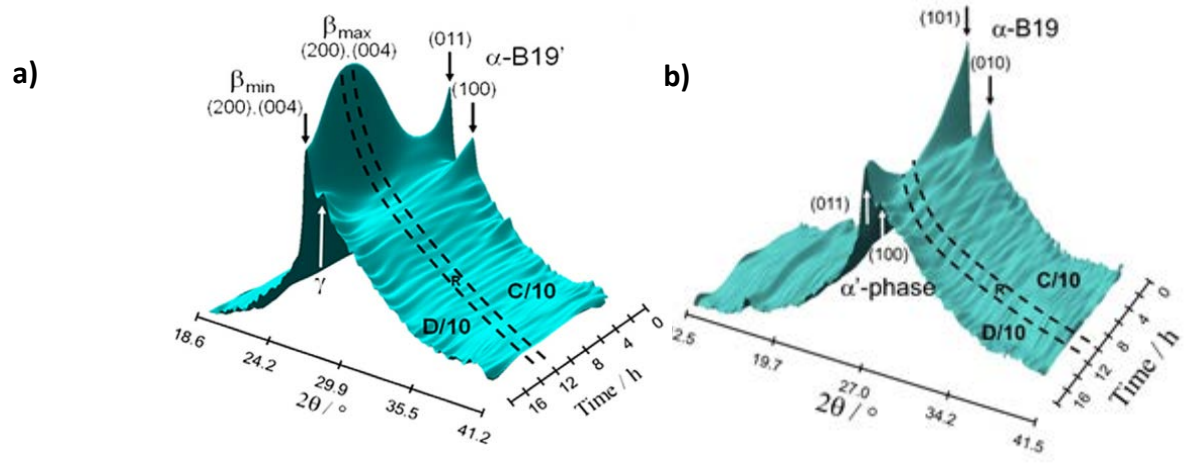
The effect of Ni by Cu substitution on the structural, solid-gas and electrochemical hydrogenation properties of TiNi has been investigated. Pseudo-binary $TiNi_{1-x}Cu_x$ ($x \leq 0.5$) compounds have been synthesized by induction melting. They crystallize in cubic *B*2 structure above 350 K and either in monoclinic *B*19' ($x < 0.1$) or orthorhombic *B*19 ($0.2 \leq x \leq 0.5$) at room temperature (RT). For all compounds, Pressure-Composition Isotherms at 423 K exhibit a single slopping plateau pressure within the range 10^{-3}–1 MPa of hydrogen pressure revealing a metal to hydride transformation. Both the hydrogenation capacity and the hydride stability decrease with Cu-content. The hydrided pseudobinary compounds crystallize in the tetragonal S.G. *I*4/*mmm* as for TiNi hydride. The electrochemical discharge capacity increases with Cu content from 150 mAh/g for TiNi up to 300 mAh/g for $TiNi_{0.8}Cu_{0.2}$ and then decreases again for larger Cu substitution amounts. Electrochemical isotherms and *in-situ* neutron diffraction measurements at RT demonstrate that such a high capacity increase results from a metal to hydride phase transformation in which the hydride phase is destabilized by Cu substitution. The $TiNi_{0.8}Cu_{0.2}$ compound exhibits interesting cycling stability for 30 cycles and good high-rate capability at D/2 rate. This compound has promising electrochemical properties as compared to commercial $LaNi_5$-type alloys with the advantage of being rare-earth metal free.



3D view of *in-situ* neutron diffraction patterns evolution as function of time during the first charge and discharge cycle of TiNi (a) and $TiNi_{0.8}Cu_{0.2}$ (b) electrode.