Magnetism and electric transport in nanocrystalline $Ce_{100-x}Al_x$ (x = 45, 50) alloys

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We report on the nanocrystalline state formation, crystallization processes, transport and magnetic properties of melt-spun $Ce_{100-x}Al_x$ alloys. The master alloy, prepared by arc-melting elemental Ce and Al, was rapidly quenched using a single roller melt-spinner with a Cu wheel. Cooling rates were controlled by the wheel surface velocity. The XRD pattern revealed CeAl nanocrystalline phase with the ClCs-type structure (*Pm-3m* space group) embedded in an amorphous matrix. This phase is metastable and exhibits random distribution of atoms in the unit cell. Because of this metastability favored method of synthetization is only just melt-spinning technique which gives the possibility of Ce_1Al_1 phase creation and avoids the formation of other phases. The constant-heating DSC curves for $Ce_{50}Al_{50}$ and $Ce_{55}Al_{45}$ show two exothermal crystallization peaks. Activation energies of crystallization were determined by the means of Kissinger approximation. The total enthalpy of the main two peaks for $Ce_{50}Al_{50}$ was about 20 J/g. Endothermic effects associated with a glass transition below the primary crystallization peak were not visible against the other effects. This may indicate the presence of dispersed polyamorphous packings with a wide range of local glass transitions. The nanocrystalline phase was found from ac and dc magnetic susceptibility, magnetization and resistivity measurements to order ferromagnetically below 21 K.