

**ABSTRACT:**

Metallic multilayers of Cu/Al/Ti composition were studied by transmission electron microscopy (TEM) and plasmon energy-loss mapping as prototypes of nanoscale reactive multilayer systems with exothermic alloy formation in oxygen-free conditions. The selection and arrangement of alloy phases by the system during ex situ and in situ heating experiments were found to depend not only on temperature but strongly on the initial volume ratios of metals, and to a lesser degree on the dimensionality of the reactive sample. Here, a two-dimensional sample was represented by ex situ heating of the full multilayer structure, a one-dimensional sample refers to in situ heating of thin cross-sectional TEM specimens, while a zero-dimensional sample (or metallic dot-array) was obtained after cutting thin pillars using focused ion beams. Lamellar self-organized alternation between Heusler phase and Cu<sub>9</sub>Al<sub>4</sub> was found.