Temperature effect on dihedral angle between metal and MgO at high pressure and high temperature

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Core forming process is one of the important events in early Earth as restricting thermal history or chemical composition. It has been suggested that there was a terrestrial magma ocean, through which core melts could segregate efficiently. But we don't know how the metallic melts moved through solid or partially molten mantle. In this study, we studied the interfacial reaction between metallic melt and mantle component, especially the possibility of percolation.

Metallic component was Fe85.5Ni9.5O5 which was a mixture of purity high Fe, Ni and synthetic Fe0.92O. As a model of mantle component, we used powdered MgO. Each material were filled into the capsule separately and set contacting with each other. The upper side was metallic component, and the lower side was powdered MgO.

Experiments were performed at a pressure of 15 GPa, at temperature between 1700oC and 2700oC using MA-8 type multianvil apparatus. The heating duration was varied from 0 to 600 min. Dihedral angle was estimated from the median of the apparent angles.

Dihedral angles increased toward equilibrium value with time. At first, melt infiltrate into MgO by volume expansion, then the texture changed gradually to decrease interfacial energy. This study indicated that, at 15 GPa, 2000oC, textural equilibrium is established at least in 60 min. As increasing temperature tends to decrease dihedral angle, it seems to be possible to percolate the metal through the mantle at temperatures above 4000oC.