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Determination of Boron distribution in Co-Re alloys

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Co-Re based alloys are being developed at the TU Braunschweig to supplement Ni-based Superalloys at ultra-high temperature (>1200℃) applications. Grain boundaries in these polycrystalline alloys are strengthened by boron. Boron is known to segregate to grain boundaries in Ni-alloys and improve low temperature ductility. The mechanisms to strengthen the grain boundaries are being explored for the Co-Re alloys. To have a better understanding of the effect, a set of experimental alloy was manufactured with known added boron amounts ranging from 50 to 1000 ppm. However, as boron is volatile, the quantity remained in the alloy is presumably lower than added.

The aims of the present experiments were to quantify the boron content by PGAA, and to map its distribution in the alloys, looking for signs of segregation. Thanks to the high cross-section of the 10B(n,alpha gamma)7Li reaction, we could detect boron already in a few ppm quantity, based on its 477.6 keV gamma-ray. A complementary technique, solid state nuclear track detectors (SSNTD) was used to map the near-surface boron density. The alpha particles, emitted from the same nuclear reaction, create tracks in the SSNTD, if we make a close contact between a polished surface of the sample and the track detector during the irradiation. The track detectors were etched in hot NaOH and imaged with an optical microscope. An attempt was also made to have a closer look to the boron-spots with SEM, giving far better spatial resolution than a conventional microscope.

Several measurements have already been carried out at the PGAA beamline of the Budapest Neutron Center. In some samples the segregation was clearly detectable. This information allows the material scientists to develop a new generation of materials.

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