[Multi] Alexandra Ledermann 8 - Les Secrets Du Haras FR ((EXCLUSIVE))

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Changes in the local and global structures of wood during maturation are related to seasonal variations in temperature, light and humidity. It is known that the cellulose microfibrils undergo modifications during the maturation process, which are linked to the deposition of lignin, hemicellulose and tannins. The aim of this thesis was to analyse how the above-mentioned molecules form structures in wood, and to demonstrate if it has an influence on the variation of the physical properties of wood from the grain to the fibers. To this end, multi-scale analyses were performed: macroscopic drying shrinkage; microscopic imaging of wood slices with a synchrotron X-ray micro-CT; and nanoscopic imaging of cellulose microfibrils with a Quanta probe. Micro-CT analysis of dried wood slices from mature tree trunks of three tree species, Norway spruce (Picea abies), white spruce (Picea glauca) and Scots pine (Pinus sylvestris), showed very similar results. Cellulose microfibrils oriented in arches covered with a lignin matrix were observed in all three species. Structureless or bcc Fe was synthesized by laser-heated zone-melting in a diamond-carbon-encapsulated arc-melting chamber. The laser-heated zone-melting (LHZM) processing using a solid-state-laser-fired preform is a high-entropy alloy fabrication technology that has the potential to be a replacement for the arc-melting technique. This new process involves melting-zone-melting in a gaseous medium and heating the powder to a temperature higher than the melting point. The main factors contributing to the efficiency of LHZM processing were: minimizing the crystallite size, growing the crystallite coherently to minimize grain boundary scattering and enhancing the chemical mixing of the alloy. During LHZM processing, the laser pulse energy is critical to the microstructure evolution. In order to optimize the chemical mixing and increase the hardness of the microstructure, an optimized laser-to-gas energy ratio was used. The hardness of the resulting microstructure was also increased by modulating the laser beam profile. The LHZM powder was loaded into a multi-anvil type DAC to demonstrate the influence of the fabrication parameters on the microstructure of the material. Experimental results show that increased laser-to-gas energy ratios yield a much more refined microstructure with better chemical mixing and higher hardness. Compressive mechanical properties of Fe-Ni-C alloys at megapascal pressures were enhanced by LHZM processing, with hardness being increased by up to 30%. The laser pulse energy (energy absorbed by the powder), which determined the chemical mixing of the alloy, also affected the mechanical properties of the material. The mechanical behavior of LHZM alloys more closely resembled that of a eutectoid Fe-C phase mixture, presumably because of the improved chemical mixing. When LHZM processing is applied to high-entropy alloys that contain no elements with volatile phases, the growth of the eutectoid phase is inhibited and a higher ductility is expected. LHZM processing produces Fe-Ni-C alloys with lower ductility compared to an arc-melted alloy, but higher hardness. The new technique has potential to be used to fabricate complex, high-entropy alloys with novel properties.less

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We precisely determined detailed phase relations of upper continental crust (UCC) at 20-28 GPa and 1200-1800 C across the 660-km discontinuity conditions with a high-pressure multi-anvil apparatus. We used multi-sample chambers packed with both of UCC and pressure marker, and they were kept simultaneously at the same high-pressure and high-temperature conditions in each run. The high-pressure experiments were carried out in pressure and temperature intervals of about 1 GPa and 200 C, respectively. At 22-25 GPa and 1600-1800 C, UCC transformed from the assemblage of CaAl4Si2O11-rich phase (CAS)+clinopyroxene+garnet+hollandite+stishovite to that of calcium ferrite+calcium perovskite+hollandite+stishovite via the assemblage of CAS+calcium ferrite+calcium perovskite+garnet+hollandite+stishovite. No CAS was observed at 1200 C. The textures and grain sizes in the run products suggested that hollandite (II) (monoclinic symmetry) was stable above 24-25 GPa and transformed to hollandite (I) (tetragonal symmetry) during decompression. We calculated the density of UCC at high pressure and high temperature from the mineral proportions which were calculated from the mineral compositions. UCC has a higher density than PREM up to 23.5 GPa in the range of 1200-1800 C. Above 24 GPa, the density of UCC is lower than that of PREM at 1600-1800 C, but is almost equal to that at 1400 C and higher than PREM at temperature below 1400 C. Therefore, we suggest that the subducted UCC may penetrate the 660-km discontinuity into the lower mantle, when its temperature is lower than 1400 C at around 660 km depth. 5ec8ef588b