Densification, grain growth and texturation in SPS nanoZnO ceramics.

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ZnO and 0.3 at% Al-doped ZnO nanoparticles have been synthesized by precipitation. An aqueous soda solution has been added to a zinc nitrate (or zinc nitrate and aluminum chloride) aqueous solution at room temperature under vigorous stirring according to the route developed by Giovannelli et al. [1]. The two samples are mostly composed by plate-like nanoparticles circa 200-400 nm large and a few tens of nanometers thick with the c-axis in plane according to TEM images and electron diffraction. The 0.3 at% Al-doped sample also exhibits nanoparticles of few tens of nanometers exhibiting an isotropic shape. Moreover, plate-like nanoparticles of the pure ZnO sample are agglomerated as sand roses. Then the powders have been densified by Spark Plasma Sintering (SPS) at temperatures ranging from 400°C to 1100°C under a pressure of 100M Pa. Their behaviour is completely different: 0.3 at% Al-doped ZnO nanoparticles reach high densities (> 95 %) since 500°C whereas pure ZnO requires temperature beyond 1000°C. The microstructures are also different. The grains of the 0.3 at% Al-doped ZnO remain nanosized at 500°C but are close to micrometer since 600°C. For the pure ZnO grain growth starts only near 1000°C. After starting growing, the grains present an isotropic shape. The quantitative X-ray diffraction texture analysis [2, 3] shows that the ceramics present a crystallographic texture with the c-axis perpendicular to the pressure application direction. The evolution of this texture has been studied over the whole temperature range for the two compositions.

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