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Industrial scale HP-HT synthesis of hard and wear resistant c-Zr_3N_4[1] DMYTRO DZIVENKO, RALF RIEDEL, TU Darmstadt, Germany, TAKASHI TANIGUCHI, NIMS, Tsukuba, Japan, THIERRY CHAUVEAU, ANDREAS ZERR, LSPM-CNRS, Villetaneuse, France — We present a large scale high-pressure high-temperature (HP-HT) synthesis of hard and wear resistant cubic zirconium nitride having Th_3P_4-type structure, c-Zr_3N_4. This material, also available as well-adhesive coatings with exceptional wear resistance, represents a compound competitive to diamond and c-BN with respect to machining of low-carbon steels and other ferrous alloys. We obtained c-Zr_3N_4 powder at pressures as low as 6.5 GPa and temperatures of 1400-1600 °C from nanocrystalline Zr_3N_{4+x} precursor using a belt-type apparatus - a static HP-HT device widely employed for the commercial production of diamond and c-BN. The HP products are characterized in details by means of powder X-ray diffraction, Raman spectroscopy, scanning electron microscopy and combustion elemental analysis. In addition to major polycrystalline c-Zr_3N_4, we unveil the formation of a quaternary compound c-$(Zr_{1-x}Ta_x)_3(N_{1-y}O_y)_4$ which indicates the possibility of doping of c-Zr_3N_4, thus introducing it for practical application as a multifunctional material. Moreover, we consider ways of cementing the c-Zr_3N_4 powders (similar to cemented tungsten carbides) which would allow economic fabrication of large bodies based on this compound.

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