Nanocrystalline Hydrous Zirconia from Zirconium Tungstate

L. M. Somavilla[1,2], J. E. Zorzi[1], G. Machado[3], G. R. Ramos[1], C. L. G. de Amorim[1], C. A. Perottoni[1,2]

[1]*Universidade de Caxias do Sul, 95070-560, Caxias do Sul, RS, Brazil*
[2]*PGCIMAT-Universidade Federal do Rio Grande do Sul, 91501-970, Porto Alegre, RS, Brazil*
[3]*Centro de Tecnologias Estratégicas do Nordeste—CETENE, 50740-540, Recife, PE, Brazil*

Nanocrystalline hydrous zirconia (ZrO_2 .$2H_2O$) with volume weighted average domain size of 1.5 nm was obtained by soaking zirconium tungstate (α-ZrW_2O_8) in boiling 1M NaOH solution for 5 h. The selected area electron diffraction pattern of hydrous zirconia particles could be indexed according to a tetragonal lattice with *a*=1.463(4)Å and *c*=2.535(6)Å. Upon heating to 60 ºC under a vacuum of 10^{-5} mbar, hydrous zirconia dehydrates reversibly. Further heating to 850 ºC and 1000 ºC resulted in the formation of tetragonal and monoclinic zirconia, respectively. Some of the nanocrystalline hydrous zirconia produced from zirconium tungstate coalesced into transparent, nearly pore-free aggregates. The formation of these almost fully densified aggregates of hydrous zirconia, and the observed dehydration under very mild conditions, suggests that it could be possible to obtain transparent bodies of zirconia, with unprecedented small crystallite size, with the controlled deposition of the extremely small hydrous zirconia nanoparticles from a water-based suspension.The extremely small crystalline domain size is probably responsible for the unusually high temperatures needed to promote the conversion from hydrous zirconia into tetragonal and monoclinic zirconia and, also, for the formation of nearly pore-free, micrometer-sized agglomerates.
Keywords: hydrous zirconia, nanocrystalline particles, zirconium tungstate.

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lmsomavi@gmail.com, Universidade de Caxias do Sul, CCET, R. Francisco Getúlio Vargas,1130, CEP 95070-560, Caxias do Sul, RS, Brazil.