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High energy ball milling of mixtures of nanocrystalline powders of gallium nitride GaN and aluminum nitride AlN

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Step 1: The nanopowders of gallium nitride GaN and aluminum nitride AlN were individually prepared by an anaerobis synthesis method via nitriding pyrolysis of the freshly made polymeric gallium imide $\{Ga(NH)_{3/2}\}n$ and aluminum amide-imide {Al(NH2)x(NH)y}n, respectively, under an ammonia atmosphere. Different pyrolysis temperatures resulted in various average particle sizes of the nitrides, all in the low nanosized range below ca. 20 nm. For GaN, the temperatures of 800 and 975 °C and for AlN – 700 and 1000 °C were applied. The powders were characterized by powder XRD, FT-IR, helium density determinations, and low temperature adsorption of nitrogen for surface property determinations.

Step 2: Mixtures of the two different nitride powders with 1:1 molar ratio were prepared, mixed first in an agate mortar, and then subjected to high energy "wet" ball milling at 900-1000 rpm in a planetary ball mill Pulverisette 7 to afford homogenously ground powders. These products were characterized similarly as the starting powders. The results are interpreted in terms of increased nitride particle amorphisation and characteristic changes in surface properties upon milling as well as of stresing a propensity of the {GaN+AlN} system to form solid solutions AlxGa1-xN. The impact of particle size on the surface properties and the mechanochemical formation of the solid solution under applied milling conditions is discussed.

Biography

Jerzy F Janik has completed his graduation in 1987 from the University of New Mexico (UNM), Albuquerque, NM (PhD in Chemistry). He has spent several years as Visiting Professor at UNM (1990-1992, 2000-2002) and at Duke University, Durham, NC (1995-1998). Currently, he is a Full Professor of Technical Sciences at the AGH University of Science and Technology, Faculty of Energy and Fuels, Kraków, Poland.

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