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Luminescence of morphologically-controlled calcium silicon nitride particles through combined techniques of ultrasonic spray pyrolysis and carbothermal reduction/nitridation

S. Ono[1], H. Kuwahara[2], H. Kuroe[2] and **K. Itatani[1]**
[1]Department of Materials and Life Sciences, Sophia University, Japan
[2]Department of Engineering and Applied Sciences, Sophia University, Japan

The morphologically-controlled preparations of Eu^{2+}-doped calcium silicon nitride ($Ca_{2-x}EuxSi_5N_8$: x = 0.05) particles, i.e., the spherical and columnar particles, were conducted by combined techniques of ultrasonic spray pyrolysis and carbothermal reduction/ nitridation. Relating to the ultrasonic spray pyrolysis, the precursor oxides for $Ca_{2-x}EuxSi_5N_8$ particles were prepared by this technique at 600°C in air, using $Ca(NO_3)_2/Eu(NO_3)_3$ solution (total concentration: 2.86×10^{-2} mol·dm^{-3}) with suspended Si_3N_4 particles. The spray-pyrolyzed powder was further mixed with carbon, and carbothermally reduced in N_2 atmosphere. The spherical and columnar $Ca_{1.95}Eu_{0.05}Si_5N_8$ particles could be prepared by controlling the heating rate and temperature for carbothermal reduction/ nitridation. The spherical $Ca_{1.95}Eu_{0.05}Si_5N_8$ particles could be obtained when the spray-pyrolyzed powder (or precursor oxides) was heated to 1000°C at the rate of 30°C•min^{-1}and then to 1400°C for 2 h at the rate of 10°C•min^{-1}. On the other hand, the columnar $Ca_{1.95}Eu_{0.05}Si_5N_8$ particles could be obtained when the spray-pyrolyzed powder was heated to 1100°C at the rate of 30°C•min^{-1} and then to 1500°C for 2 h at the rate of 10°C•min^{-1}. The morphological control was conducted by the kinds of liquid phases formed during the heating process. The morphological control of $Ca_{1.95}Eu_{0.05}Si_5N_8$ particles could be achieved by the nitridation of spherical and columnar particles formed at 1000°C or 1100°C. The emission peaks of spherical and columnar $Ca_{1.95}Eu_{0.05}Si_5N_8$ particles appeared at 622 nm and 618 nm, respectively, under the excitation at 375 nm. Overall, the spherical and columnar $Ca_{1.95}Eu_{0.05}Si_5N_8$ particles could be formed by controlling the heating rate and temperatures for the carbothermal reduction/nitridation of spray pyrolyzed oxide powders. The spherical and columnar particles emitted the lights with the peak wavelength at 622 and 618 nm under excitation at 375 nm.

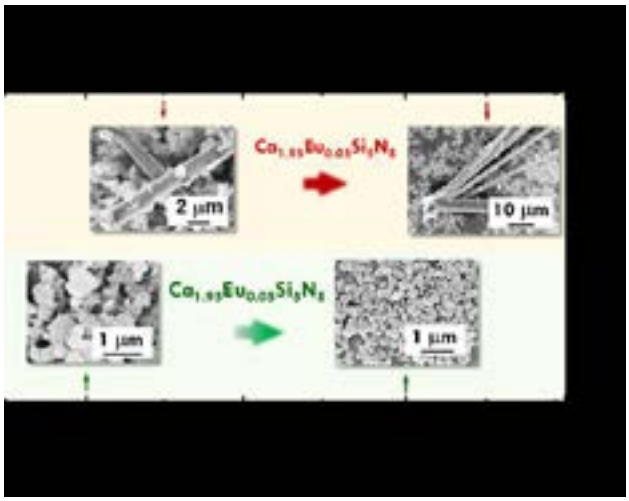

Figure1: *Morphological changes of particles with temperature*

Biography

Satoshi Ono is a student of Sophia graduate school. His research interest is preparation and characterization of Si_3N_4-containing nitride ceramics.

satoshi0517@eagle.sophia.ac.jp

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