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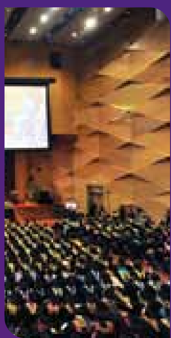

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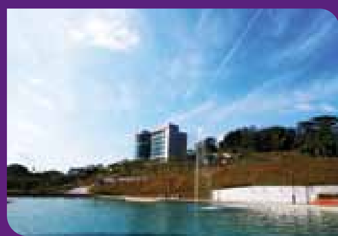

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Name : **Misbah Binti Hassan, *PhD***

Title : **Effects Of Hot-Spot Temperature, Microstructure And BaA12O4 Addition On Oxygen Sensing Properties Of REBa2CU3O7-δ(RE=Er, Dy) Ceramic Rods**

Faculty : **Applied Sciences**

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Oxygen sensing properties of REBa2Cu3O7-d-based (RE123, RE = Er and Dy) ceramics utilizing the hot spot phenomenon have been investigated. Although shorter rods of around 12 mm are more practical for industrial use compared to previously reported rods longer than 30 mm, their oxygen sensing properties have not been previously reported. Bulk 123 materials were synthesized using the conventional solid-state method and fabricated into short rods of around 12-mm length with cross sectional area of 0.65 mm ´ 0.65 mm. In the first part of this study, influence of hot-spot temperature in the range of 160 °C to 810 °C on oxygen sensing behavior of Er123 rods was studied. Simultaneous measurements of hot-spot temperature and output current response in different oxygen partial pressures between 1 % and 100 % with hot-spots operating at temperatures as low as 660 °C in 1 % oxygen partial pressure produced good sensor current stability as well as repeatability. Response time for oxygen sensing was observed to decrease with increasing hot-spot temperature, with minimum value of 0.50 s recorded at 695 °C in 1 % oxygen partial pressure. In addition, a large change in activation energy of oxygen ion migration from 2.8 eV to 0.626 eV was established at around 670 °C. By using wider Er123 rod, it was demonstrated that hot spot formation starts from local heating at a point of defect before growing in size. In the second part of this study, performance test of the sensor from as low as 0.025 % pO2 to 100 % pO2 showed very good repeatability and stability of output current. Electrical conductivity for pO2 from 5 % to 100 % showed good proportional relation to pO21/6 and in agreement with the mass action law. In the third part of this study, effect of addition of $BaAl_2O_4$ on the durability of Er123 rods was studied. It was found that although durability was enhanced, the addition also increased minimum power consumption of Er123 rods. Interestingly, further addition of $BaAl_2O_4$ from 5 to 30 wt.% has resulted in a reduced minimum power consumption from 1.23 to 1.16 W. Compared to using longer Gd123 rods as reported in a previous study, using Er123 with 30 wt. % $BaAl_2O_4$ has proven to lower minimum power consumption by at least around 42%. Addition of $BaAl_2O_4$ also reduced the fluctuation of current and increased the sensitivity for below 10 % pO_2. In the fourth part of this study, oxygen response of hot spot on Dy123 ceramic rods fabricated under different heat treatments has also been studied. It was observed that increasing the sintering temperature from 900 °C to 960 °C reduced the voltage at peak current by half but only slightly reduced the power consumption. In terms of durability the best performance is shown by the sample which was sintered for 48 hours at around 900 °C. The sample which was reheated at around 910 °C for 24 hours after being fabricated into rod shape showed the largest reduction in voltage at peak current and the lowest in power consumption but it was the least durable. The effect of heat treatment on I-V behavior was discussed in terms of differences in microstructure and initial oxygen content of the samples. These studies have shown that stability of hot-spot based oxygen sensing properties of shorter RE123 rods of around 12 mm in length is influenced by hot-spot temperature, addition of $BaAl_2O_4$ as well as changes in microstructure as a result of differences in heat treatment. Electrical conductivities of the rods involve oxygen ions and obey the mass action law. At the end of this study, a qualitative model of a special material to control maximum hot-spot temperature based on the temperature at maximum resistivity of the rod material for ceramic rods with hot spot has been proposed.