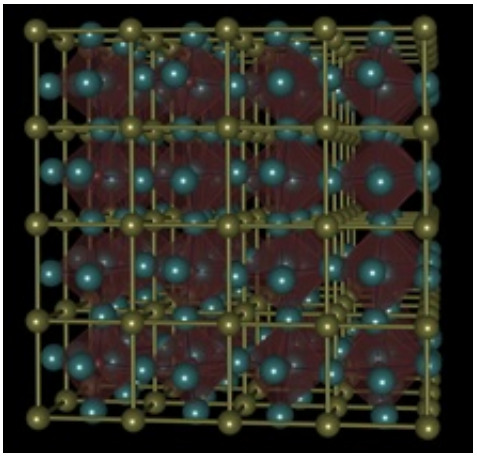
Perovskites can improve fabrication of ceramic electronics

March 12 2015, by Mikiko Tanifuji



Crystal structure of LaCo0.5Ni0.5O3 based on a rhombhedral lattice. Credit: STAM

Scientists in Japan are finding that perovskites have the potential to improve the fabrication of electrodes and wiring in ceramic-based electronics such as spark plugs.

Many ceramic-based electronics, such as spark plugs and multilayer ceramic capacitors (found in consumer electronics, mobile phones, DVDs and video cameras, for example), are composed of a combination of oxides and metals. The oxides are used as a base to provide the product's electric, optical or magnetic properties, while the metals are used in electrodes, which propagate the electrical signals. Fabricating

these products is difficult because the physical properties of the oxides and metals are very different. To achieve a high quality product, the manufacturing process needs to account for differences in synthesis temperatures and atmospheres, and for differences in expansion and shrinkage. A fabrication process that is optimized for the conducting metal electrodes can suppress the performance of the base oxides.

In a review paper published in the journal *Science and Technology of Advanced Materials*, a group of scientists in Japan investigated the potential of replacing metal electrodes in ceramic-based electronics with conductive oxides. Doing so could allow for more innovations in the ceramics industry. Oxide electrodes in these ceramic-based products would need to be highly conductive (above 1000 Siemens/cm) and stable in air at temperatures ranging between room temperature and 1173 Kelvin (almost 900° Celsius).

The team of researchers, from NGK Spark Plug Company and Nagoya University, fabricated oxides that have the potential to replace metal electrodes and investigated their physical properties above room temperature. Lanthanum-based perovskite-type oxides were chosen as having a potential for industrial use because they do not contain expensive rare metals, they are not environmentally hazardous, and they are stable in air up to 1173 Kelvin.

Based on their investigations, the team found that the lanthanum-based perovskite-type oxide $LaCo_{0.5}Ni_{0.5}O_3$ showed high electronic conduction at high temperatures in air and was suitable for the fabrication of oxide electrodes and wiring in ceramic-based products.

More information: "Electronic conduction in La-based perovskite-type oxides" *Sci. Technol. Adv. Mater*. Vol. 16 (2015) 026001 DOI: 10.1088/1468-6996/16/2/026001

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