

ZnO-coated high-performance bearings developed

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Small jet engine generator equipped with ZnO-coated bearings for emergency use (Lights in the back are being turned on using the power produced by the generator). Credit: NIMS

A research group consisting of National Institute for Materials Science (NIMS) and Tohoku University developed a coating technique using a zinc oxide (ZnO) material, an environment-friendly, low-friction material developed exclusively by NIMS. When bearing balls were

coated with the ZnO material, the material's low frictional characteristics were maintained and the friction coefficient of the bearing was reduced by approximately one-third.

A research group—consisting of Masahiro Goto, distinguished chief researcher, Center for Green Research on Energy and Environmental Materials, NIMS; Michiko Sasaki, postdoctoral researcher, Center for Materials Research by Information Integration, NIMS; Masahiro Tosa, group leader, Research Center for Structural Materials, NIMS; Kazue Kurihara, professor, and Motohiro Kasuya, assistant professor, Institute of Multidisciplinary Research for Advanced Materials, Tohoku University—developed a coating technique using a [zinc oxide](#) (ZnO) material, an environment-friendly, low-[friction](#) material developed exclusively by NIMS. When bearing balls were coated with the ZnO material, the material's low frictional characteristics were maintained and the [friction coefficient](#) of the bearing was reduced by approximately one-third. Moreover, the research group and Fox Corporation jointly developed a small jet engine generator for emergency use. By integrating the ZnO-coated bearings into the generator, its fuel consumption was reduced by 1%.

In consideration of worsening global environment/energy issues, it is important to reduce friction occurring in drive mechanisms including engines in terms of energy saving. However, because the mechanically driven part in an engine becomes extremely hot, friction reduction technology applied in such an environment must be heat resistant. We focused on ZnO, capable of both reducing friction and resisting heat, and identified its friction reduction mechanism at the nano level. Then, we developed a basic technique to apply a low-friction ZnO coating by controlling the crystal orientation of ZnO.

In efforts to put the developed basic technique to practical use, we applied the technique to reduce the friction level of commercially-

available, high-performance bearings to an even further extent. We developed the technique for applying ZnO coating to bearing balls while controlling the crystal orientation of the ZnO material by rotating bearing balls in cage-shaped sample holders. As a result, we succeeded in reducing the friction coefficient of the bearings by approximately one-third. In addition, we integrated the resulting bearings into a small jet engine, evaluated its performance, and observed a 1% reduction in fuel consumption. Furthermore, we worked to miniaturize generators to be used in times of emergency when procurement of fuel is difficult. In this effort, we succeeded in developing a small [jet engine](#) generator equipped with ZnO-coated bearings. It weighs only about 40 kg, and can be carried by two adults. This compact generator, however, can produce 8,000 W of power, which can approximately cover the amount of power consumed by two households, and will be made available for emergency use.

The newly developed low-friction ZnO coating is expected to be applicable not only to bearings but also to any mechanically driven parts that require [friction reduction](#), given that the coating is usable in a wide range of conditions: from room temperature to high temperature, in oil, in vacuum and in atmosphere. By applying this coating technology to different types of mechanically driven parts in systems such as automobiles, it may be possible to save energy in these systems.

This study was conducted in line with the university-led green innovation project "Green Network of Excellence (GRENE)" sponsored by the Ministry of Education, Culture, Sports, Science and Technology. More specifically, this study was carried out in accordance with the "Green Tribology Innovation Network" project (Principal investigator: Professor Kazue Kurihara, Tohoku University) within a GRENE category, the "Advanced Environmental Materials." We will give a presentation on this study on August 5, 2016, during the PRICM9 meetings to be held in Kyoto.

Provided by National Institute for Materials Science

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