

Physicists discover keys to improving magnet technology

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Permanent magnets are important in a broad variety of commercial technologies, from car starters to alternators for wind power generation to computer hard drives. Researchers at the U.S. DOE's Argonne National Laboratory have found new clues into ways to make those magnets longer-lasting and more powerful.

Using the Western Hemisphere's most powerful X-rays at the Advanced Photon Source at Argonne, the researchers were able to see new details of rare-earth ions, a critical component of permanent magnets. The examination of the ions, probing their magnetism with unprecedented resolution, revealed that the presence of rare-earth ions in more than one atomic environment reduces the magnetic stability of the best-performing permanent magnets to date. This knowledge will enable manufacturers to manipulate the rare-earth ion atomic structure for optimization of future magnets.

The research is published this week in *Physical Review Letters*.

Rare-earth ions come from metallic elements that share similar chemical properties; they are not especially rare, but they are used sparingly because of the high cost in preparation of the materials. Rare-earth ions play an important role in determining magnetic stability against demagnetizing fields, and therefore in magnet performance.

"The research found that rare-earth ions in dissimilar crystalline environments compete with one another, and undermine the magnetic

performance of the highest performance magnets," said Argonne scientist Daniel Haskel, who led the research team. "These findings point to the need for specialized atomic engineering of the material – manipulating the rare-earth local atomic structure to fully utilize the rare-earth contribution in next generations of magnets."

Source: Argonne National Laboratory

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