New interferometer could simplify materials research

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(PhysOrg.com) -- "Most current hard x-ray interferometers are based on crystals, which require their high quality and high mechanical stability," Anatoly Snigirev tells *PhysOrg.com*. "This can make x-ray interferometry quite limited. What we have done is develop a different set up that is simpler." Snigirev is a scientist at ESRF in Grenoble France. Along with scientists at the Russian Kurchatov Research Center in Moscow, and at IMT RAS in Chernogolovka, Russia, Snigirev proposes that refractive bilenses made from silicon can be used in place of crystals.

"We can get an interferometer that is more in line with classical visual optics," Snigirev says. An interferometer works when beams of light are sent through slits or lenses, and patterns are detected against a background on the other side. The patterns reveal information about the object of study. "Our technique is sensitive enough for diagnostics and accurate measurements, and is more stable and easier to set up than using crystals." Information on the work done by Snigirev and his colleagues is found in Physical Review Letters: "X-Ray Nanointerferometer Based on Si Refractive Bilenses."

Using electron beam lithography, the lenses used by Snigirev and his peers were created by a process of deep reactive-ion etching into silicon. "We prepared concave lenses, and put them in a row. This inline approach increases the refraction power," Snigirev explains. "Varying the number of individual lenses it is possible to focus x-rays at different distances from meter to milimeter focus distance and use this technique for nano-focusing."

Rather than relying on double slit-type interferomter, which is difficult to accomplish and because of low resolution and loss of intensity, this team relied more on an interferometer related to the Billet split lens. In this classical optics technique, a lens is cut along the optic axis. This still allows for interference to be measured, but the intensity remains high, and the resolution is better.

Snigirev points out that one of the advantages of this system is that it is tunable. . "You can tune this 'nanoruler' system easily by changing x-ray energy or by moving objects along the optical axis." Another advantage of the system is in the silicon construction of the lenses. "Silicon is very stable," Snigirev explains. "It can also take a high heat load, as from a beam. In this case we are using x-rays, but it could be used for future X-ray Free-Electron laser projects."

Indeed, the possible future applications of this interferometer set up have promise. "This could be very attractive for materials research," Snigirev insists. "It would allow us a better look at photonic and colloidal crystals, multilayer structures, as well as other natural and synthetic mesoscopic materials".

"Interferometry is used a great deal right now, and it could be improved for research into materials and also for other purposes. It is a very important technique," Snigirev continues. "However, as it is done now it can be difficult to implement. Our approach is simpler, and it could really help in the development of future applications and materials development."

More Information: A. Snigirev, et. al., "X-Ray Nanointerferometer Based on Si Refractive Bilenses," *Physical Review Letters* (2009). Available online:

http://link.aps.org/doi/10.1103/PhysRevLett.103.064801.