Argonne NATIONAL LABORATORY

Office of Technology Transfer

Improved Anti-Scatter Grids and Collimators

New Fabrication Method Enhances X-Ray, Nuclear Imaging to Save Lives, Reduce Medical Costs

2006 R&D 100 Award Winner

ANTI-SCATTER GRIDS

Benefits:

- More accurate and simpler image analysis and interpretation
- Reduction of mammogram x-ray dose by up to 13%
- Non-complex fabrication method
- Applicable to existing and new imaging systems.

COLLIMATORS

Benefits:

- Higher sensitivity and better image resolution
- Minimal image distortion
- Faster image acquisition
- Ideal for use with latest digital solid-state detectors

BEYOND MEDICAL IMAGING

Uses of nuclear-imaging collimators:

- Drug delivery and efficacy
- Gene targeting
- Physiological stimulation effects
- Sites, modes, of action and bio-distribution of new drugs
- New radiotracers.

Advanced grids for x-ray systems (LIGA):

- Improved nondestructive inspection methods
- High-precision measurement during semiconductor production
- Protein crystallography research.

Modern medical imaging technologies enable doctors to detect, diagnose, and treat diseases earlier and more accurately. The tools they employ include x-rays, magnetic resonance, ultrasound, and nuclear imaging.

Researchers at Argonne National Laboratory have developed improved components that enhance the quality of the images produced by x-ray and nuclear imaging systems – two of the most widely used technologies.

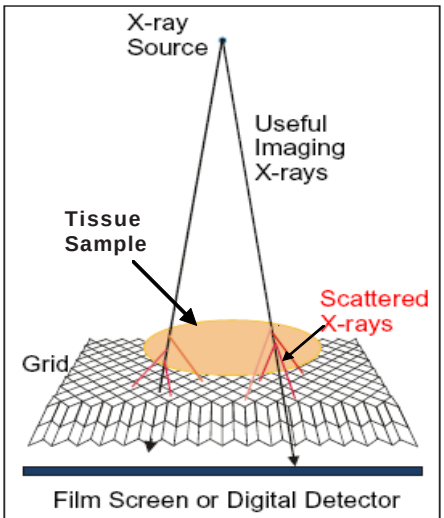
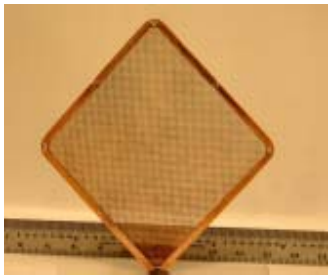


Figure 1. Schematic of an anti-scatter grid. Human tissue attenuates and scatters x-rays. The two-dimensional grid absorbs scattered x-rays, so that the primary x-rays propagate to the imager.

Seeking a Clearer Image

X-ray imaging is used to study organ shape and structure in mammography, chest x-rays, and computerized tomography (CT) scans. Some x-rays are partially absorbed as they travel through tissue and bone in their direction of propagation to create an image on special film. But some x-rays also are scattered at random angles, resulting in fog or other artifacts that can reduce contrast in the x-ray image by up to 50%.



Anti-scatter grids can improve X-ray imaging, used in mammography, chest X-rays and other medical applications

Similar degradation can occur during nuclear imaging, in which higher-energy gamma rays help illuminate the function and chemistry of organs. Nuclear imaging is important in clinical evaluation of small cancerous tumors.

To prevent image degradation, two devices – anti-scatter grids and collimators – are used with x-ray systems and nuclear imaging systems, respectively. These devices are designed to absorb scattered radiation, preventing the incidence on the imaging screen, while allowing as much of the primary radiation as possible to pass unimpeded.

Improved LIGA fabrication method possible applications:

- Integrated circuits interconnections
- Higher-quality bio-filtration membranes
- Micro-reactors for producing chemicals or biological products
- Micro-fluidic devices and diagnostic "bio-chips"
- Micro-molds for making miniature components.

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ABOUT ARGONNE TECHNOLOGY TRANSFER

Argonne National Laboratory is committed to developing and transferring new technologies that meet industry's goals of improving energy efficiency, reducing wastes and pollution, lowering production costs, and improving productivity. Argonne's industrial research program, comprised of leading-edge materials research, cost-saving modeling, and unique testing and analysis facilities, is providing solutions to the challenges that face U.S. manufacturing and processing industries.

Improving the Fabrication Method—LIGA

The anti-scatter grids and collimators now commercially available have limitations that result from the methods and materials used in their construction. Researchers at Argonne and Creatv MicroTech, Inc. (Potomac, MD) have developed an improved process for making cost-effective anti-scatter grids and collimators that offer higher performance and other advantages compared to available products. The basic fabrication process is called LIGA, a micro-machining technology for making high-precision miniature components. (LIGA is an acronym of the German words for the lithography, electroplating, and molding steps used.) The grids are now ready for commercialization.

Benefits of the Improved LIGA Method

X-ray anti-scatter grids and nuclear collimators produced using the improved LIGA process offers higher image resolution, lower image distortion, and faster image acquisition. The improved grids allow transmission of about 90% of desirable x-rays compared to about 65% with current grids. And the level of undesirable scattered radiation is significantly reduced (from about 10% to less than 1%).

The LIGA process also can create grids and collimators with square holes/channels that are more compatible with new-generation digital detectors.

In human terms, advanced grids and collimators will help save lives and reduce medical costs by enabling radiologists to interpret x-ray and nuclear imagery more quickly and accurately.

Potential Market Impact

The improved imaging components from Argonne and Creatv MicroTech are expected to find wide application in growing markets. The market potential is sizeable.Shipments of x-ray and other irradiation equipment (for both medical and non-medical use) reached $5.20 billion in 2004, up by 48.4% from 2000.

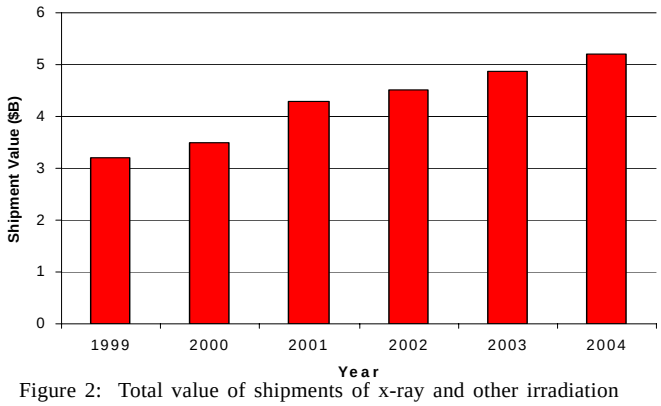

Figure 2: Total value of shipments of x-ray and other irradiation equipment (medical and non-medical uses) by U. S. companies, 1999

September 2006

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