

## ATP-Funded Optics Technology Produces Large Energy Savings in Petroleum Refineries and Distribution Systems

While X-rays provide intense penetrating power for precise materials analysis and industrial process control, X-rays until recently could not be easily focused or collimated. ATP-funded capillary optics technology overcomes this problem and offers practical solutions for a wide range of industrial applications.

A new study sponsored by ATP/EAO of ATP-funded optics technologies examines the economic benefits for diverse industrial applications of miniature capillary arrays in the following areas:

- ❖ Laboratory materials analysis for a broad range of industries;
- ❖ Process control metrology for petroleum refineries and distribution systems; and
- ❖ Process control metrology for semiconductor fabrication.

Based on this study, quantified economic benefits include:

- ❖ At least \$23,000 in operating cost savings per optic, per annum used in laboratory materials analysis.
- ❖ Over \$123,000 annual energy savings from each in-line sensor engine employing X-Ray optics in petroleum refineries (beginning in 2004).
- ❖ Over \$70,000 annual energy savings from each in-line sensor engine employing X-Ray optics in petroleum distribution systems (beginning in 2005).

Benefits to the nation are expected to far exceed the ATP investment:

### **Total Net Benefit to the nation**

- ❖ Net Present Value (\$2004): \$184 to \$233 million (of which \$7.4 million has been realized to date)

### **Benefit to the nation of every dollar invested**

- ❖ Benefit-to-cost ratio: 75:1 to 94:1

### **Rate of return to nation on public investment**

- ❖ Public return on public investment: 49% to 53%

### Background

Prior to ATP funding, capillary optics technology was a laboratory curiosity. In 1991, ATP funded the new company X-Ray Optical Systems, Inc., (XOS) to address underlying modeling, materials, and manufacturing issues impeding commercial development. The project targeted two major obstacles to commercial use, (1) bending of thousands of miniature glass tubes in a uniform manner to form precisely engineered arcs, and (2) discovering which materials could withstand intense x-ray beam irradiation. The miniature capillary arrays developed exhibit the following characteristics: (i) they consist of tiny, slightly curved glass tubes held; (ii) they form a convergent beam to provide intensity gains as high as  $10^3$ ; (iii) they form collimated (parallel) beams with low divergence; and (iv) they suppress X-rays not from desired source or direction.

Source: *Photonics Technologies: Applications in Petroleum Refining, Building Controls, Emergency Medicine, and Industrial Materials Analysis* by Thomas M. Pelsoci, Delta Research Co., NIST GCR 05-879. September 2005.

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