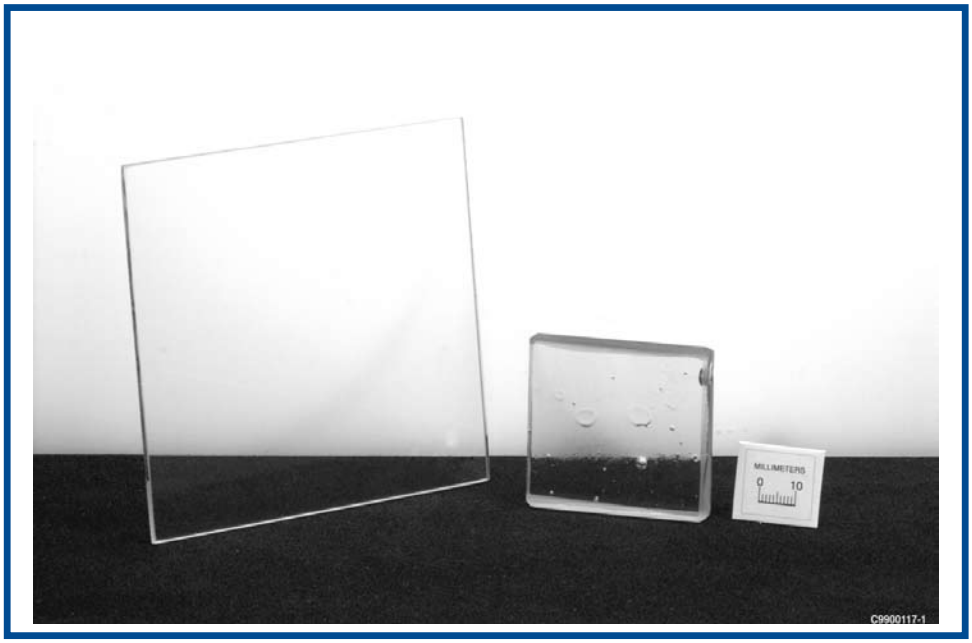
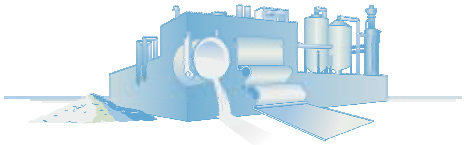
Redox State Sensor Technology in Glass Melts

Robust Sensor Would Improve Product Quality

Sensors currently used in the glass industry for gauging the reduction-oxidation (redox) components of glass melts are limited in scope and not well suited for industrial environments, given their propensity to break, corrode, or measure inaccurately. Better, on-line measurement and control of these components, which affect glass properties such as tint and fining, will allow manufacturers to improve final product quality and reduce waste. Researchers at Oak Ridge National Laboratory worked in partnership with Energy Research Company to develop a robust sensor for reliably measuring the ratios of various redox components in glass melts.



The sample on the left is transparent and free of defects—a high-quality product formed in an optimal redox state—while the sample on the right has a green tint that is characteristic of unbalanced redox chemistry.



Benefits for Our Industry and Our Nation

- Optimized production efficiency as a result of redox monitoring
- Improved product quality

Applications in Our Nation's Industry

Once developed, this simple redox sensor could be integrated with a thermochemical model for predicting glass properties based on the chemistry of the melt and a control strategy for adding reductants or oxidants during glass production to improve the final product.

Project Description

Goal: Develop a simple, robust sensor to measure the ratios of redox components in a glass melt during processing.

The redox sensor is based on an earlier technology, also developed by Oak Ridge National Laboratory, used to determine uranium oxidation state ratios in molten fluoride nuclear reactors. This redox sensor will be commercially viable because of its ability to determine ratios reliably even in the presence of added, potentially interfering components.

Progress and Milestones

Successfully completed initial feasibility study

- Cyclic voltameetry system was set-up
- System validated with an aqueous Fe(II)/Fe(III) study
- Tested in a molten glass environment at 1450° C
  - Corrosion of the aluminum oxide electrical insulation material was found to occur
  - Surface reactions of Pt electrode were found to occur at limiting potential of the melt
  - Successfully observed the redox couple of Fe(II/Fe(III) if limiting potential avoided
- Method shows promise, but more research and development effort is required
- This project concluded in 2000.

Project Partners

Energy Research Company
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Oak Ridge National Laboratory
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