

**ANNUAL PROJECT REPORT  
AS OF DECEMBER 2001**

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|--|---|
| <p>1.    <b><u>PROJECT SPONSOR</u></b><br/><br/><u>Department of Chemical Engineering</u><br/><br/><u>The University of Cincinnati</u><br/><br/><u>601 Engineering Research Center</u><br/><br/><u>Cincinnati, OH 45221-0171</u></p> | <p>2.    <b><u>PROJECT MANAGER</u></b><br/><br/><u>Dr. Vadim V. Guliants</u><br/><br/><u>Professor</u><br/><br/><u>Phone: 513-556-0203</u><br/><br/><u>Email: Vadim.Guliants@uc.edu</u></p> |
| <p>3.    <b><u>OCDO GRANT NO.</u></b> OCRC3-01.1C2.14</p>  |   |
| <p>4.    <b>PROJECT UPDATE <u>__X__</u> OR<br/>FINAL REPORT</b></p>  |   |
| <p>5.    <b><u>PROJECT TITLE:</u></b> <u>Novel Amine-Modified Silica Membranes for Separation of<br/>Carbon Dioxide under Ambient Conditions</u></p>   |   |
| <p>6.    <b><u>PROJECT TERM:</u></b>   <b>FROM:</b> 9/1/01                      <b>TO:</b> 8/31/02</p>   |   |
| <p>7.    <b><u>BUDGET:</u></b>                      <b><u>NAME</u></b>                      <b><u>COST SHARE</u></b></p>   |   |
| <p>  <b><u>OCDO</u></b>                      \$80,000</p>  |   |
| <p>  Univ. Cincinnati            \$26,804</p>  |   |
| <p>  <b>TOTAL PROJECT COST</b> \$106,804</p>   |   |

## I. ABSTRACT

### 8. OVERVIEW OF PROJECT & OBJECTIVES:

Reducing atmospheric CO<sub>2</sub> emissions for addressing climate change concerns is becoming increasingly important. The currently investigated CO<sub>2</sub> mitigation technologies require CO<sub>2</sub> in a concentrated form. However, the CO<sub>2</sub> from large sources, such as flue gas from coal-fired power plants, is present at ~15% concentration. Therefore, capturing CO<sub>2</sub> from low purity sources is an important step for many mitigation technologies. Membrane separation methods are particularly promising for CO<sub>2</sub> separation from flue gas due to high CO<sub>2</sub> selectivities and fluxes achievable and favorable process economics. The focus of the proposed research is to develop novel amine-modified mesoporous silica membranes for CO<sub>2</sub> separation from flue gas. The overall objective of the three-year research program is to establish amine-modified silica membranes as a new viable technology for capturing CO<sub>2</sub> from flue gas.

### 9. WORK DONE & CONCLUSIONS:

Since the start of this project in September of 2001, we recruited a new graduate student, obtained the necessary equipment and supplies, and began experimental work on the preparation of mesoporous silica membranes, assembly of a multicomponent gas permeation system, and membrane permeation tests.

### 10. PLANS FOR COMING YEAR:

In the coming year, we will further focus on the synthesis of mesoporous silica membranes. Its objective will be to identify the best mesoporous silica membranes with respect to structure and adhesion properties. Several amino groups will be attached to the pore surface of the best membranes and the CO<sub>2</sub>/N<sub>2</sub> separation studied using the new gas permeation system. Quantum chemical calculations of interactions of CO<sub>2</sub>, N<sub>2</sub> and H<sub>2</sub>O with the attached amino groups will be conducted to validate this theoretical approach, understand the observed separation of these molecules, as well as select new promising amino groups for surface attachment during the 2<sup>nd</sup>-year research. We will further investigate the tolerance of the best performing membranes to the presence of typical flue gas impurities, e.g. SO<sub>x</sub>.

## II. HIGHLIGHTS/ACCOMPLISHMENTS

11. In a relatively short time since the start of this new project, we successfully prepared a first series of defect-free mesoporous silica membranes which display a high trans-membrane flux of gas molecules.

## III. ARTICLES/PRESENTATIONS

12. Since this is a new project for 2001, no articles/presentations have been made on the subject of this research. We have submitted an oral presentation on mesoporous silica membranes for CO<sub>2</sub> separation at the 7<sup>th</sup> International Congress on Inorganic Membranes that will take place in the summer of 2002 in Dalian, China.