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This second quarter of Grant DE-FG22-94PC94222 continued to see progress on the three fronts reported last quarter: (1) instrument construction; (2) polymer synthesis and (3) membrane fabrication and microscopy.

- A computer-controlled permeameter has been constructed and is undergoing "shake-down" testing and calibration. This system was modeled after ones currently in use at Los Alamos National Laboratories and is capable of automated operation. The instrument runs under a Lab View™ control program. A Residual Gas Analyzer has been incorporated to enable the direct determination of membrane permselectivity (α) toward gas mixtures. The present configuration incorporates a simplified test cell to house the membranes, and allows for rapid survey work of polymers that are modified *ex situ*. A new cell for *in situ* electrochemical modification of these membranes is under design. Figure 1 displays the complete permeameter instrument which includes the pumping system, the thermostatted chamber that houses the test cell and attendant gas handling systems, the electronics control rack and the data acquisition/analysis computer. Figure 2 is a close-up of the electronics rack and Figure 3 the computer monitor which displays the LabView Virtual Instrument control screen.
Polymers based on 3-substituted thiophenes have been synthesized in quantities sufficient for preliminary assessment of their performance as membrane separators. These include regioregular (head-to-tail) and regiorandom poly(3-octylthiophene), POT, and poly(3-dodecylthiophene), PDDT, and regioregular poly(3-methoxyethoxyethoxy-thiophene), PMEET. These materials have been characterized by usual spectroscopic techniques (FTIR, FTNMR) and their molecular weights and polydispersities determined by size exclusion chromatography (SEC) against polystyrene standards. Films of these materials have been constructed using a polymer casting table.

We have established a sampling protocol to assess the uniformity of the cast films via optical (OM) and tapping-mode atomic-force (TMAFM) microscopies. Films are cast using a 0.75 mL aliquot of a 10% solution of the polymer in chloroform and the same four general areas are imaged using TMAFM on each of five films. Statistical results of roughness are then calculated. For regiorandom POT the RMS roughness ($R_{rms}$) is $0.54 \pm 0.09$ nm, which indicates that the cast films are quite uniform. Pinhole defects were not evident in these films.

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