PHASE-SEPARATION CHARACTERIZATION OF POLYETHYLENEOXIDE-CONTAINING COPOLYIMIDES FOR GAS SEPARATION MEMBRANES

Ángel Marcos-Fernández[1,2]*, Ángel E. Lozano[1,2], José G. de la Campa[1,2], Javier de Abajo[1,2], Roberto Recio[1,3], Alberto Tena[1,3], Laura Palacio[1,3], Pedro Prádanos[1,3], Antonio Hernández[1,3]
[1]*Unidad Asociada ICTP-SMAP, Edificio I&D, Campus Miguel Delibes, Universidad de Valladolid, Paseo Belén, 47001 Valladolid, Spain*
[2]*Instituto de Ciencia y Tecnología de Polímeros (ICTP), CSIC, Juan de la Cierva 3, 28006 Madrid, Spain.*
[3]*Dpto. Física Aplicada, Facultad de Ciencias, Universidad de Valladolid, Real de Burgos s/n, 47071 Valladolid, Spain*
**email: amarcos@ictp.csic.es*

Recovery of CO_2 from gas mixtures is an important industrial objective and polyimides consisting of flexible polyethyleneoxide (PEO) segments and rigid aromatic polyimide segments have been reported in recent years for this application. They exhibit high CO_2 permeability coefficients and excellent CO_2/N_2 selectivity due to CO_2 strong affinity to the polar PEO segments.

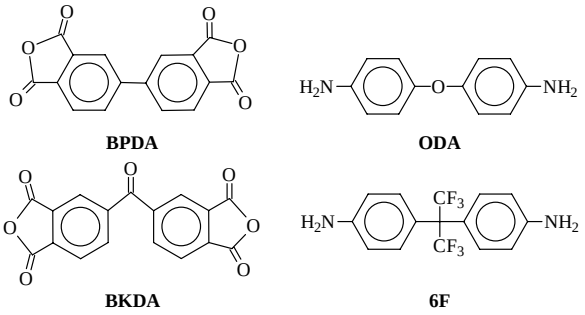

Figure 1. Structure of the aromatic dianhydride and diamines

In this work, a set of copolyimides with different PEO contents and Mn (900, 2000 and 6000 g/mol) is presented. Two different dianhydrides and two aromatic diamines were used to prepare the polymers (Figure 1). Membranes from the synthesized polymers were cast, and their physical properties characterized. Special attention was focused on the study of the phase segregated morphology by SAXS.

The phase separated structure of the PEO 6000 based polymers was improved by thermal treatment, in particular for the polymers with lower PEO content, which increased PEO crystallinity (as measured by DSC) and influenced the physical properties. Real time experiments on the synchrotron line showed an increase on the invariant and changes on the long spacing during thermal treatment (Figure 2). For polymers based in shorter PEO chains, phase separation was greatly influenced by the chemical structure of the aromatic polyimide segments. When degradation temperatures were reached, loss of PEO segments took place, and for the PEO 6000 based polymers, the partially pyrolyzed polymers (up to complete loss of PEO segments) showed a nanoporous structure.with good mechanical properties.

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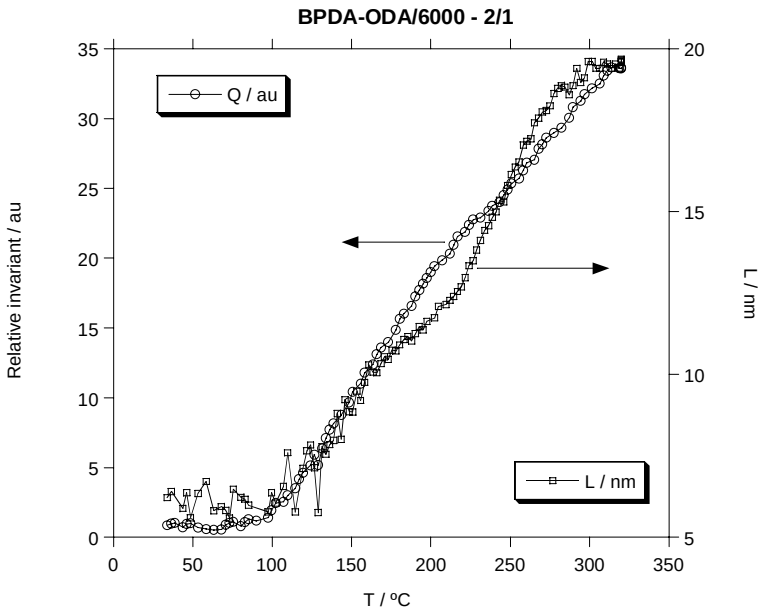

Figure 2. Real time values for relative invariant and long spacing for the copolymer BPDA-ODA/6000 2/1 (by weight)