

## **Título: Gas Transport in Polymers: Applications In Membrane Separation And Barrier Packaging**

### **Programa con distribución horaria de temas:**

- **Introduction and motivation:** Why studying mass diffusion and sorption in solid materials and the main applications: membrane separations, packaging, material production, sensors. (1 hours)
- **Theoretical background:** local and integral mass balance, Fick's law for diffusion, definition of permeability and solubility coefficient, solution-diffusion theory. Dependence of the transport parameters on penetrant and polymer characteristics as well as on various operative parameters (empirical correlations. Effect of swelling or relaxation, polymer plasticization. (8 hours)
- **Experimental techniques** to inspect gas permeability, solubility and diffusivity in polymeric materials: fundamentals of the different techniques, manometric, gravimetric, magnetic, infrared-based techniques. (3 hours)
- **Available models for gas solubility and diffusivity in polymers:** equations of state models (for rubbers), non equilibrium models (for glasses); the free volume theory (for diffusion). (5 hours)
- **Analysis of gas transport in complex systems:** semicrystalline polymers, composite materials, reacting systems (3 hours)
- **Application 1: polymers for barrier packaging:** analysis of main requirements for some relevant packaging systems (e.g. food products), modified atmospheric packaging MAPs; main features for oxygen barrier systems and for moisture barrier; discussion of active systems for controlled release or scavenging. (5 hours)
- **Application 2: polymer membranes for gas separation:** analysis of some relevant process and environmental gas separation (e.g. natural gas sweetening, carbon capture or hydrogen purification), discussion of the main requirements, introduction on membrane separation and definitions of key membrane performances and discussion of the permselectivity trade-off and the Robeson upperbound; discussion on the main polymer based solutions for the targeted separations. (5 hours)