Mónica Faria, Cíntia Moreira, Maria Norberta de Pinho

CeFEMA / Departamento de Engenharia Química, Instituto Superior Técnico,
Universidade de Lisboa
Av. Rovisco Pais, Lisboa 1049-001, Portugal

monica.faria@tecnico.ulisboa.pt

Hemocompatible Membranes for Blood Oxygenators

Cardio Pulmonary Bypass (CPB) for open heart surgery and Extra Corporeal Membrane Oxygenation (ECMO) for longer-term lung support are clinical practices that make use of Membrane Blood Oxygenators (MBO). These devices have at their very core membranes that separate the patient's blood from gases and that allow oxygen to enter and carbon dioxide to leave the blood stream. Even though MBOs have been used in CPB for over 30 years, and in ECMO support devices for 10 years the insufficient hemocompatibility of the materials remains a problem and hazards of CPB and ECMO include bleeding disorders, systemic inflammatory reactions, multiorgan failure and pulmonary dysfunction. Presently, research efforts are directed towards developing new membranes with tailored optimal surface/bulk morphologies with high gas permeation properties and enhanced hemocompatibility capable of sustaining lung support for lengthier periods of time. Biomedical polyurethanes are associated to high hemocompatibility and fatigue resistance. These block copolymers typically have an ether or an ester soft segment with an aromatic or aliphatic hard segment and a urethane or urethane/urea linkage. Over the last years the structural versatility of polyurethanes with two soft segments has been subject of intense investigation in our group for the synthesis of asymmetric gas permeable membranes. Having in mind the incorporation of these membranes in blood contacting devices and namely in membrane blood oxygenators, two main goals drove the synthesis of bisoft segment polyurethane membranes: i) The enhancement of O2 and CO2 gas permeation rates, and ii) The enhancement of the hemocompatibility. This work focuses on the synthesis of bi-soft segment poly (ester urethane urea) (PEUU) membranes suitable for ECMO devices. Gas permeation properties are evaluated and membrane surface characterization is investigated at the submicron level. Furthermore a strong correlation between membrane surface properties at the nano scale and blood compatibility is established contributing to the enhanced hemocompatibility of PEUU asymmetric membranes through the tailoring of top dense surface morphologies.

References

[1] M. Faria, P. Brogueira, M.N. de Pinho, Colloids Surf. B Biointerf. 86 (2011) 21–27

[2] M. Faria, V. Geraldes, M.N. de Pinho, M. Faria, V. Geraldes, Int. J. Biomater. (2012) vol. 2012, Article ID 376321, 9

[3] M. Faria, M. N. de Pinho, European Polymer Journal. 82 (2016) 260–276

Figures

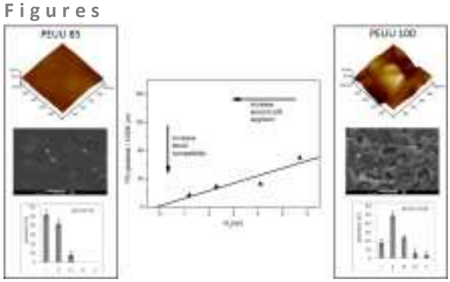

Figure 1: Linear correlation between the sub-micron roughness and platelet adhesion on the active layer surface of polyurethane urea membranes