

# Shervin KHAKPOUR

ESR 6, **CNR-ITM**, Italy

## PhD Research Activities

October 2014

### **Bioartificial liver using hepatocytes and endothelial cells**

This project, titled “Bioartificial liver using hepatocytes and endothelial cells”, is carried out within BIOART’s work package 3. The main objective is realization and optimization of a hollow fiber membrane bioreactor (HFMBR) used for cell culture, based on mass transfer and fluid dynamics studies. The development of an innovative bioreactor which ensures viability and functionality of cells – hepatocytes in this case – is very challenging, complex and expensive, both financially and timely. Mathematical modelling of the system provides a powerful tool to better understand the mechanisms that dominate bioreactor’s performance and to identify the decisive parameters and operative conditions.

#### **Current research investigates the bioreactor by experimental and mathematical means.**

The permeability study of molecules/proteins of interest present in the system is currently being finalized. Additionally, parameters required for the modelling are being evaluated.

The mathematical model developed to best describe the transport phenomena in the HFMBR will be numerically solved using COMSOL Multiphysics. Extra-capillary space (cell compartment) consists of either a layer of attached cells or attached spheroids, and for each condition mass transfer through the layer/spheres is evaluated. The model will be expanded to have cells in the lumen of the hollow fibers as well.

Once the operative culture conditions are established (through modelling), liver-specific functions of the bioreactor containing hepatocytes will be evaluated.

#### **Expected outcome**

Upon completion of this study, an optimized, fully operative HFMBR capable of providing a suitable environment for hepatocytes is expected to be achieved. Moreover, a user-friendly model is planned to be developed so that experts without a background in engineering could also use it to adapt/analyze the bioreactor for different culture conditions.