# ELECTROCHEMICALLY CONTROLLED POLARIZED LIQUID – LIQUID INTERFACE MODIFICATION WITH POLYAMIDES

Polyamides are part of a large group of chemical compounds called polymers. Nylon® is their popular representative. It was invented in 1934 by W.H. Carrothers and turned out to be an incredible discovery due to its unique properties. Its synthesis can be performed in a very spectacular way using a system based on two immiscible liquids. The reagents needed for a polyamide synthesis are separated from each other by means of an extremely thin membrane formed by solvent molecules that do not want to penetrate each other – in professional terminology it is called liquid – liquid interface (visible with naked eye after mixing an oily liquid with water). Appropriate selection of experimental conditions allow for a spontaneous, easy and quick reaction that results in the formation of ductile polyamide films at the interface of two immiscible liquids. Movies illustrating the seemingly endless extraction of "a thread" from a beaker filled with the liquids containing appropriate reagents can be easily found on-line. These reactions are known as the nylon rope trick (https://www.youtube.com/watch?v=S6asCwVG8zU). Resulting material holds exceptional properties applied in a range of applications. The special features of the polymers obtained in this way include, among others, tensile and abrasion resistance, non-flammability and high mechanical strength even with long periods of use. Due to these characteristics, polyamide based compounds are desirable in many fields such as construction materials in the aviation or automotive industry. They are an important component in the clothing industry (raw material for the production of clothes), sports (ropes - lines - fishing lines) or the demanding scientific sector (production of specialized materials resistant to aggressive solvents).

So far, it was mainly the organic chemistry that has been involved in the preparation and improvement of polyamide based materials. The innovative idea of this project assumes the control of the polyamides synthesis by means of electrochemistry at the liquid – liquid interface. The basic principle of rely on the controlled transfer of ions (chemical compounds with a positive or negative charge) from one phase, e.g. water, to the second phase, e.g. the oily phase. All this takes place in specially designed vessels equipped with a set of electrodes through which electricity flows.

In this project, the effect of electrochemistry on the behaviour of a number of reagents needed to produce polyamides at the liquid – liquid interface will be tested. The implementation of the assumed goals will allow thorough understanding of the electrochemically controlled polycondensation reaction as well as improvement of the production process of selected polymeric materials. Another aspect that will be addressed during the project duration is polyamides electrochemical decoration with functional materials at the liquid – liquid interfaces. The selected modifiers are titanium dioxide ($TiO_2$) and para-aminobenzoic acid (PABA). Due to their unique properties that allow them to absorb UV radiation, the produced hybrid materials can find potential applications in the textile industry. Another innovation proposed in this project is the synthesis of polyamide films within microscopic liquid interfaces located in the glass pores of microcapillaries. The size of the holes (pores) of these carriers can be compared to the thickness of the hair cut several times along its axis. The resulting devices will be used to produce electrochemical sensors in which polyamide films will act as molecular sieves impermeable to large molecules such as proteins. The interdisciplinary nature of the proposed project will allow the development of many scientific fields such as electrochemistry, polymer chemistry, nanotechnology, separation methods, material chemistry as well as analytical chemistry.