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Mein Zeichen: MP
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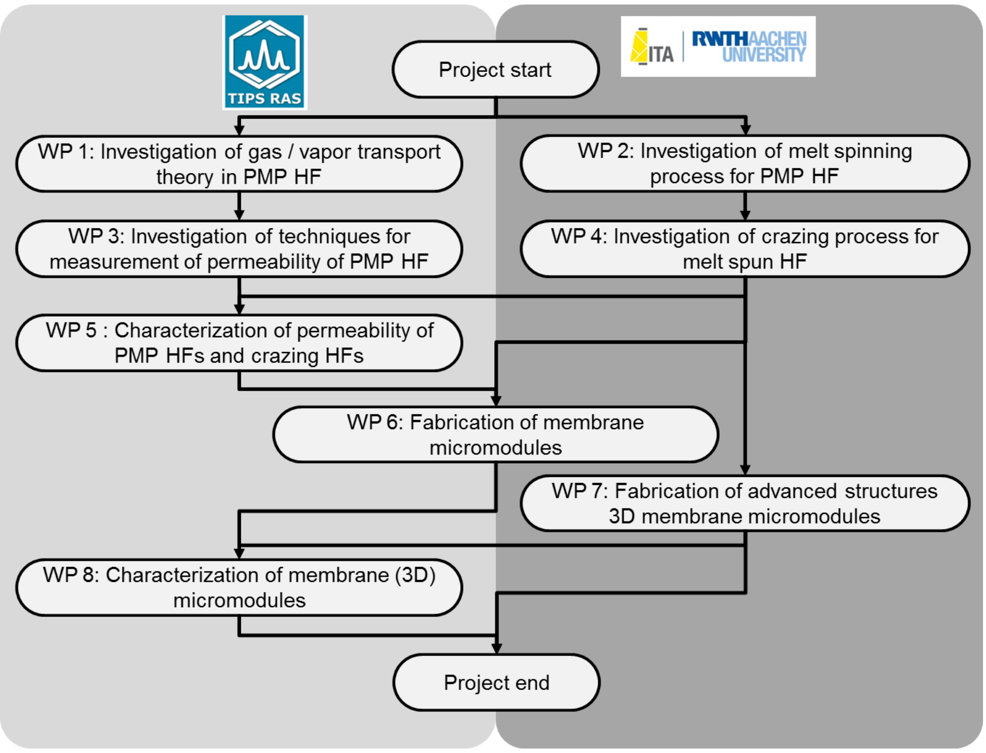
Project titel:	Development of gas (vapor) separation hollow fibers based on green technology approach and new 3D woven design of membrane modules
Partners:	A.V. Topchiev Institute of Petrochemical Synthesis (TIPS RAS), Moscow
Duration:	04/2019 – 03/2022
Funding:	DFG

Mission Statement:

Currently there is need for the creation of targeted membranes designed for particular separation purposes. An integrated membrane system for filtration and gas separation is widely required. Despite the active study of hundreds of polymers as potential membrane materials only a few of them are applied for the production of commercial membranes. The strict selection of polymers for membranes production does not depends only on the mass transfer properties, but also on rheological, mechanical and chemical properties, stability in process conditions and economically reasonable availability of the polymer. Poly-4-methylpentene-1 (PMP) takes special place among a number of membrane polymers as it meets the above noted requirements. The drawback of PMP application for membranes is that traditional manufacturing process of asymmetric hollow fibers (HFs) based on PMP requires the use of harmful solvents and precipitants. The manufacturing process suggested in the Project assumes the application of the melt-spinning technology for the PMP HF membrane production. Further, the published data on the parameters of gas permeability for PMP is limited. In recent years interest in PMP as a membrane material is intensified. The effect of permeable crystalline phase on the gas separation properties of PMP is systematically investigated in the framework of the grant RFBR No.15-03-03033. The theoretical and experimental analysis of PMP is aimed to determine the influence of the crystalline phase on the gas separation properties.

Approach:

The project aims at the development of innovative PMP HF with thin selective layer via a solvent free melt-spinning process. For this purpose, the theoretical principles of the transport theory of gases and vapors in semi-crystalline HF with different orientation of the crystallites over the thickness of the selective layer have to be developed. In order to obtain porous structure and thin selective layer the production of the HF will be done using a two-stage process. At first an oriented yarn will be produced via melt spinning process. The second process step includes annealing, drawing and crazing of the HF. Therefore, a detailed examination of the crazing in the immersion bath is necessary. Of particular interest are the effects of crazing on the structure and permeability of the PMP HF. This in turn requires the development of measurement methods for measuring the permeability of gases (H_2, O_2, N_2, CO_2, CH_4), low molecular hydrocarbons and vapors in the individual HFs and HF bundles obtained from a partially crystalline PMP. In addition, the development of 3D membranes will be examined by weaving. The development of 3D membranes provides a new range of easily scalable membrane devices of almost any shape demanded. TIPS RAS will focus on the characterization of the membrane properties and will define the framework of the melt spun PMP HFs and the 3D membrane structure. The ITA will design the manufacturing process taking into account the requirements placed on the fibers and the necessary textile structure of the 3D membranes. This includes the process development of melt spinning process for PMP HF, the design and process development of the crazing process. The 3D weaving process will be adapted by ITA to enable production of 3D HF membranes.



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