Preparation of materials with controlled properties is very important from the application point of view. Based on this it is possible to choose appropriate material depend on the final application. Such control of properties can be carried out by attaching the appropriate molecules (e.g. silanes, magnetic particles) to the material surface (Fig. 1). It should be highlighted that for the creation of materials with controlled properties the understanding of modification mechanism is a crucial issue. Moreover, another essential property of the material is character of the surface (hydrophilic – wetted by water and hydrophobic – resistant to wetting by water).

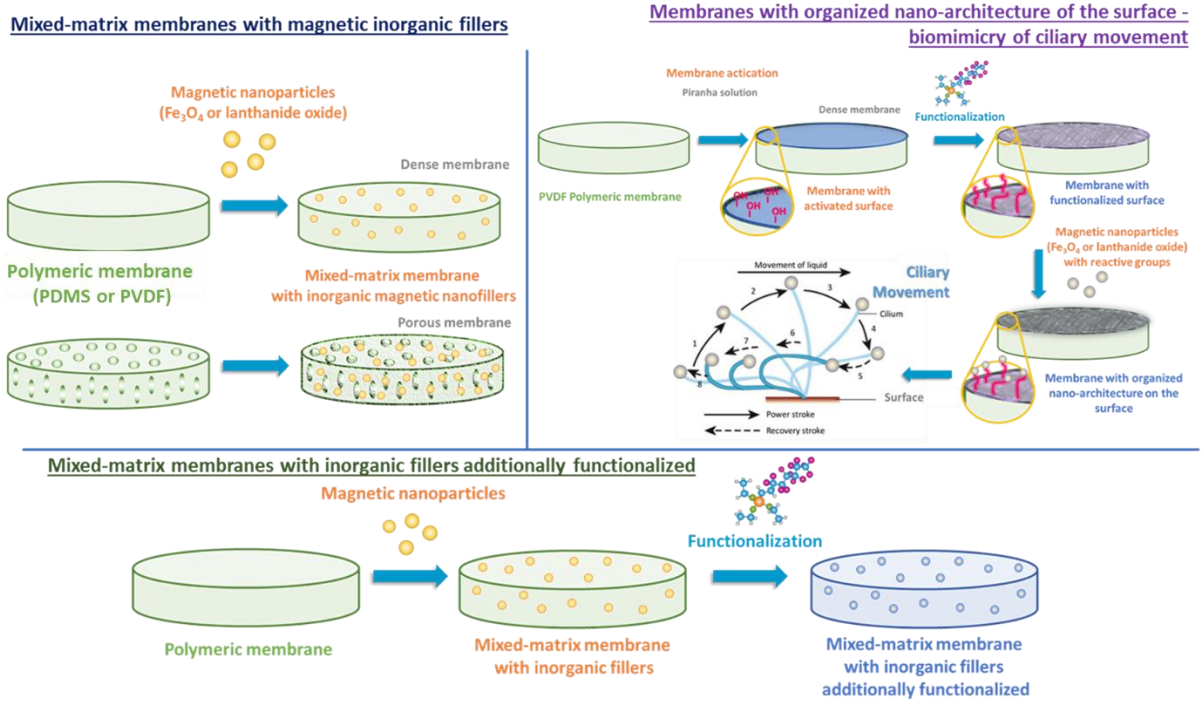

Fig. 1. Types of membranes planned to prepare.

In the project, the innovative hybrid (organic-inorganic) separation materials with controlled properties will be designed and investigated. Three types of materials will be performed (Fig. 1):

- **mixed-matrix membranes** (dense and porous) **with inorganic fillers having magnetic properties** (*e.g.* Fe_3O_4, and chosen lanthanides oxide Gd_2O_3, Nd_2O_3, Sm_2O_3);
- **mixed-matrix membranes with inorganic fillers additionally functionalized** by using silane based modifiers to reduce surface energy;
- **PVDF membranes with organized nano-architecture of the surface** - realized by a chemical modification (covalent attachment of magnetic nanoparticles *e.g.* Fe_3O_4 or lanthanides oxide to the membrane surface by chosen linkers – **biomimicry of ciliary movement**).

The physicochemical (e.g. resistance to wetting by water and other solvents) and tribological (related to the mechanical resistance - resistance to abrasion) properties will be controlled to some extent. Very important aim of the research is related with understanding of the mechanism of modification process realized at various experimental conditions. The designed and well-characterized materials will be evaluated in membrane separation processes, membrane distillation, pervaporation, ultra- microfiltratio processes, for water purification from micropollutants (*e.g.* pharmaceuticals), removal of volatile organic compounds (VOC) from water by membrane distillation or pervaporation. Moreover, membranes with incorporated magnetic nanoparticles will be tested in gas separation process.