For centuries, the human race has been fascinated by the phenomenon of magnetism. Everyone remembers his first experience with magnetism: the amazement and curiosity when watching a metallic object sliding across the table under which the magnet was moved. However, magnetism also has more practical applications. The non-surgical treatment of tumours, the implantation of electrodes, the positioning of catheters inside the brain, or medical diagnosis by MRI are also due to the action of magnetic fields and magnets.

The newest group of magnets are materials whose magnetic properties can be altered by selecting appropriate central atoms and ligands (molecular magnets) or by adding atoms of a suitable element to the structure of selenospinels. This allows a magnet to be designed with unique properties most desirable for a given application. In our project, we plan to place molecular magnets and/or selenospinels in alginate membranes and investigate such types of membranes in carbon dioxide air purification. Although both nitrogen and carbon dioxide molecules are diamagnets, the magnetic susceptibility of CO_2 is stronger than that of N_2 molecules causing the possibility of their effective separation in a magnetic field. Consequently, in the presence of a magnetic field, N_2 molecules are much more strongly repelled, causing increased permeability of CO_2 molecules.

The proposed research topic is important for both ecology and a circular economy. It also fits in the trends of the 'European Green Deal', which promotes the reduction of carbon dioxide to at least 55% by 2030. This is because carbon dioxide is responsible for the greenhouse effect, which causes global temperatures to rise. Its separation from the air is therefore an important aspect of caring for our planet. Of the various methods of carbon dioxide separation, membrane techniques appear to be the most environmentally friendly and economical. They do not require the provision of energy as well as the presence of additional substances. Previous studies have used various artificial polymers as polymer matrices. In our project, we propose to use sodium alginate as the polymer matrix. It belongs to the polysaccharides, naturally occurring in the environment. The advantage of using such a polymer is its biodegradability, allowing the recovery and reapplication of used molecular magnets and selenospinels in the production of new membranes. Furthermore, membranes containing a filler in the form of mixed molecular magnet powder with selenide chromite are also considered for examination. We assume that the properties of such a mixed filler should be due to the advantages of each of them, thanks to the synergistic effect accompanying the combination of substances with different properties.

In the last task, cluster analysis will be used as one of the methods allowing the precise selection of membranes with the best separation properties for the CO_2/N_2 mixture. These membranes will be used for further application studies to implement them in industrial processes.