An optimized membrane inlet system (MIS) for underwater mass spectrometry (UWMS)

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The pressure resistance in the deep ocean is most important for in-situ measurements. In case of the underwater mass-spectrometry (UWMS) especially the requirements of the combination of high permeability for fast low detection limits and stable structures for pressure resistance in the membrane-inlet-systems (MIS) are challenging. In the third funded project "SensorEplus" a MIS is redesigned and optimized to get high pressure resistance with high gas permeability.

The specific details in this project are pressure stability of up to water depth of 4000 m (400 bar), and a high porosity of the membrane supporting structure for gases to get low limits of detection for several gases and chemicals.

While comparing these requirements with natural structures of diatoms in the ELISE department of the AWI-Bremerhaven (http://elise.de/en/), it was found a design solution: a kind of tree stabilization inside of the "German Frit" with a very porous surrounding surface. The designed component has a cylindrical form with a diameter of 1/8" at a length of 13 mm. To realize the production of a small and complex component like this, the manufacturing process of micro-printing as a generative manufacturing is used.

Additionally a new heating management is adapted in the redesigned MIS. By heating the membrane a constant temperature is achieved and potentially energy can be saved. Also the use of a heat exchanger enables a constant temperature while saving energy.

To check the stability of the MIS the components are tested in a high pressure tank at the AWI facilities to prevent a failure of each component. The permeability of the new developed MIS will be tested with the AWI-UWMS to get a comparison of the old MIS supported by a spring and the new structure.

Here, we will present the evolution process and the structure of the new "German Frit".