The symbiotic microbiome system is a major determinant of human health. The dysfunctional intestinal microbiota is an issue which causes long-term health consequences. The currently known microorganisms delivery solutions based on various supporting materials allow for some improvement in beneficial microorganisms delivery. However, their weak structural/chemical engineering makes their surface and interface hostile and effective bio-seeding and co-operation cannot be achieved. This corresponds to failure in forming the efficient micro-domain network systems, and ordinary medicinal products need to be supplemented to be able to compete with the strongly established opposed microbiomes. The increasing resistance of intestinal microbiota toward traditional therapies has become a serious problem worldwide and is associated with many disorders and side effects. Therefore, there is a strong demand for developing new solutions for selective and effective microbiota management.

Large efforts and undertakings are currently invested in recognizing the biotechnological potential of 2D nanomaterials beyond graphene. While 2D nanomaterials' physical-type nature favours efficient mechanical exfoliation, it unfortunately does not support the biochemical-type interactions, exclusively necessary for achieving and controlling the surface bio-functionalization. Advances in nanomaterials technology nowadays provide many opportunities for developing alternative therapies and synthesizing innovative bioactive agents. As a result, the discovery of new types of nanomaterials with unique bioactivity rapidly fertilizes the field of bio-nano-science. Recently, two-dimensional (2D) nanomaterials have gained a lot of attention due to their outstanding biological activity. However, in the field of biological activity, graphene-based materials have so far shown their efficiency in microorganisms' killing yet being inappropriate for microbiome delivery.

The most recent member of the flatland includes the family of MXenes. MXene phases are also known as the early transition metal carbides, nitrides, and carbonitrides, having formula $M_{n+1}X_nT_x$, in which ‘M’ is early transition metal such as Ti or Nb, ‘X’ stands for carbon or nitrogen, T_x is the collective surface terminations such as -OH or -Cl, and n=1, 2, 3 or 4. Currently there is tremendous interest in newly obtained MXene phases since they bring the greatest innovation potential among their two-dimensional fellows. As noted, the majority of MXene-related outstanding results correspond to the superior activity and performance of their surface. This can also have a huge impact on the biological field.

The 2DMICRONET project pioneers aims at tailoring MXene surface to serve as a bio-platform with precisely controlled morphology, structure, and chemistry toward developing efficient micro-domain network systems and directly addresses the grand challenge on both European and World levels to preserve a healthy society and improve people's well-being. Such designed MXene-based micro-domains could further naturally show the therapeutic action and efficiently fight the oppose pathogenic micro-organisms. In the future, such self-sustainable bio-vehicles could be used for a novel microbiome replacement therapy - an alternative to currently used methods.