Scalable production of high quality two-dimensional materials using eco-friendly liquid-phase exfoliation methods

Graphene and other two-dimensional (2D) nanomaterials, have attracted worldwide attention owing to their fascinating properties. Since 2008, when liquid-phase exfoliation (LPE) method for graphene production was initiated, it open a new way for whole range of 2D materials production. Bearing in mind the achievements of recent years, the constant development of LPE will have great influence on scalable production of high-quality graphene monolayers. The knowledge and technologies used in graphene exfoliation for sure will have impact on all 2D materials, so gained experience can be applied to other nano-materials research and exfoliation processes.

Among various exfoliation techniques, liquid phase exfoliation (LPE) is very promising due to its high quality and purity of exfoliated layers, scalability of the process and low cost of production. LPE has high potential for the mass production of 2DMs due to fact that basics devices are widely available, tested and used in many different technologies. Improvement of LPE methods in both scientific and industrial aspects will certainly attract significant attention in the next few years.

Thus, this project is related with the development of state-of-the-art, effective and method for various 2D flakes production using liquid phase exfoliation approach using only ‘green’ environment without surfactants, hazardous solvents or oxidizing agents. The method can provide high quality defect-free 2D flakes without need for complex chemical processing. Combining of different physical forces during exfoliation process in ‘green’ liquid medium with statistical analysis 2D flakes properties is the key to develop stat-of-the-art, efficient, large scale and eco-friendly method for production of various defect-free 2D materials beyond graphene, with controlled size and thickness. This novel approach in the production method provides scalability, reproducibility and allows to tune electronic, optical and structural properties of produced flakes.

Two-dimensional materials exhibit a set of remarkable properties making them attractive components for wide range of technological applications. Tons of 2DMs are needed in application such as printed electronics, conductive coatings and composite fillers. Inks based on graphene and 2DMs will be used in flexible electronics devices, smart-clothing, smart-surfaces in home and office, sensors and so on. Due to this tremendous progress we still need fundamental scientific research, particularly in relation to material synthesis, defects control, efficient characterization and scalable production. This are only small part of the applications that can be revolutionize by 2D materials, but all of this applications require big-scale improvements in exfoliation process.