“Electrohydrodynamic (EHD) phenomena in gaseous media with surface dielectric barrier discharge”

In this project electrohydrodynamic (EHD phenomena in the gaseous media, which are generated by the surface dielectric barrier discharge (SDBD) has been investigated experimentally. At present this subject is studied in many academic and industrial research centres. The majority of these studies is focused on the application of the so called SDBD plasma actuators for modifying and controlling the airflow around air-plane wings. However, despite the substantial efforts made in the recent years there is not any essential progress in the practical improvement of SDBD plasma actuators in terms of the actuator effectiveness for the aerodynamic applications. It is a common opinion that the behaviour of the SDBD on the dielectric surface is a key point for improving the performance of SDBD plasma actuators, and that this stagnation can be overcome if the better knowledge on the physical fundamentals of electric discharges and their capability of producing the EHD flow is gained. Therefore, our project has been aimed at enhancing the interdisciplinary knowledge of the physical fundamentals and mechanisms of EHD phenomena induced by the SDBD in single- (e.g. in air) and two-phase gaseous flows (e.g. in mixtures of air and microparticles). Ensuring such an objective necessitates a deeper study of the fundamentals of SDBD. When performing the research on the SDBD and EHD flow induced by it, we realized that our tasks had to be complemented with the selected research on the corona discharge and EHD flow induced in air and two-phase medium: air-microparticles. We expected that such an approach gives useful information due to close similarity of both discharges, the SDBD and corona. As it appeared, the results of our studies on the corona discharge and the EHD phenomena induced by it were helpful in the interpretation of the results obtained when studying the SDBD. Moreover, our study of the corona discharge resulted in new data in the field of EHD phenomena generated by the corona discharge. One of them is the potential of corona discharge for generation of relatively strong EHD flows.

This project resulted in experimental and diagnostic infrastructures for advanced studies of the electrical and optical properties of electric discharge plasmas and the induced EHD flows in air and two-phase medium: air-microparticles. In terms of scientific achievements, a new research field, which pertains to the electric discharges in gaseous two-phase media has been initiated. The essential achievements of the projects are the results on visualisation and description of the morphology and characteristics of the SDBD in air as well as in the two-phase medium: air-microparticles. Also the results on EHD flow structures of the microparticles are an important achievement. No less important is the demonstration that the SDBD can be employed for the electrofiltration of two-phase gaseous media. In addition to the frontier research on the SDBD and EHD flow induced by it in the two-phase gaseous medium, also the similar research on the corona discharge and EHD flow, accompanying it, has brought important results.

The new fundamental knowledge gained in this project is a valuable contribution to better understanding the physics of generation of the SDBD and corona discharge and EHD flows induced by them. This new knowledge is expected to be useful for the validation of the existing models and the proposal of more realistic models of the EHD phenomena generated by the electric discharges. Our proposal to give rise to a new research direction: “electric discharges in two-phase media” increases the activity field of the electric discharges.

Despite the undoubtedly fundamental character of our research, they refer to the practical applications of electric discharges, among others to the manufacturing of microelectrofilter for collecting dust and microbiological hazards in small rooms, e.g. in hospitals.

The results obtained in this projects have been already disseminated through publishing them in recognised and respected journals. This is one form of our contribution to the progress in the field of “electric discharges in single- and two-phase media”.