In recent researches, the combination of non-thermal plasma (NTP) and catalysts have been shown interesting results for methane and propene decomposition. The use of NTP-catalyst systems not only increase the catalyst activity but also decrease pollutant emissions (NOx, O3, CO …) [1-2].

In this research, dielectric-barrier discharge (DBD) reactor was coupled to catalysts based on palladium(0.5-1% wt) supported on alumina spheres with different diameters (1.0, 1.8, and 2.5 mm) were tested for decomposition of volatile organic compounds-VOCs (CH₄ and C₃H₆) in air at atmospheric pressure and temperature in the range 20-300°C. The reactions were performed in continuous flow system at a total flow rate of about 1L/min with methane and propene concentrations of about 1000ppm. The cylindrical DBD reactor was powered by pulsed high voltage generator delivering HV amplitude (16-20kV) at frequency up to 200Hz. The reactants and reaction products were analyzed by Fourier Transform Infrared Spectroscopy (FTIR, Nicolet 6700, ThermoFisher Scientific), Gas Chromatograph (CP 3800, Varian), Electrochemical Analyzer (VarioPlus, MRU), and Ozone analyzer (In-2000, LoCon).

The catalyst size and noble metal loading impacts on the VOCs decomposition efficiency were investigated using three configurations: (i) plasma alone (without catalyst), (ii) in-plasma catalysis (IPC), and (iii) post-plasma catalysis (PPC) according to temperature (20-300°C). Results indicated that methane and propene could be converted by plasma without catalyst at room temperature. However, the coefficient rates of CH₄ not exceed 10% and many by-products were observed. When alumina spheres and alumina spheres supported palladium catalysts were combined to plasma reactor, the interaction of the catalyst active phase with the reactive species produced by NTP (O₃, O, OH, O₂…) change the catalyst activity leading the increasing the VOCs conversion efficiency even at room temperature. In that case, the concentration of by-products such as N₂O, CO, O₃, and HNO₃ decreased drastically. The alumina spheres supported palladium catalysts showed higher efficiency and better CO₂ selectivity comparing to results obtained when only alumina spheres were used.