The application of FT-IR spectroscopy in plasma-catalytic processes

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The study concerns the use of FT-IR spectroscopy to analyse plasma-catalytic processes for CO_2 valorisation. Application of both plasma and catalysis aims at gaining synergetic effect between them and it allows efficiently converting CO_2 even at room temperature. Under such conditions, both plasma and catalyst influence each other resulting in changed properties of both components. The abundance of plasma species, their interactions with each other and with the catalyst surface make the overall process complex and there is a need to develop new techniques and methods to understand plasma-catalytic processes.

In our work, we applied FT-IR spectroscopy to analyse several aspects of plasma catalytic processes. Firstly, we investigated CO_2 adsorption on the surface of Ni-containing hydrotalcite-derived mixed oxides under low pressure glow-like plasma discharge. The obtained results (Figure 1) confirmed that plasma modifies catalyst surface and promotes formation/activation of strong basic sites and desorbs CO_2 from weak and medium strength basic sites.

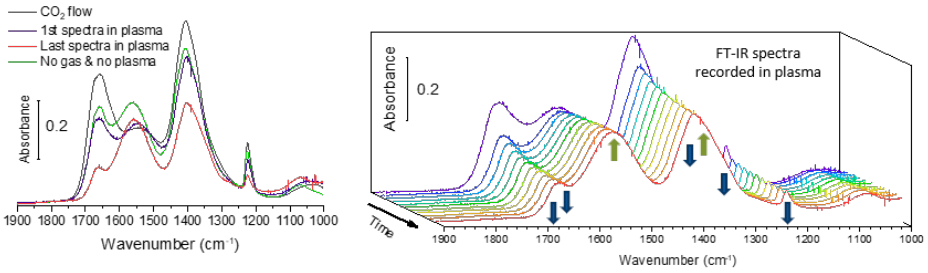

Figure 1. FT-IR spectra recorded at room temperature during operando experiments of CO_2 adsorption on nickel-based hydrotalcite-derived catalysts [2]

The study on CO_2 methanation on Ni supported catalysts under glow plasma discharge or thermal conditions followed by FT-IR spectroscopy [3] revealed that plasma may as well influence nickel active sites resulting in synergetic effect under plasma conditions and improve activity under thermal conditions ('plasma memory'). FT-IR studies of the CO_2 methanation mechanism proved that plasma does not change possible reaction mechanisms. However, it may activate new active sites and thus open new reaction paths or activate substrates *via* processes/reactions occurring in plasma gas phase. All in all, our studies showed that infrared spectroscopy is a powerful tool for characterizing plasma-catalytic processes.

References:

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