

# A microwave-assisted catalytic pyrolysis of lignin model compounds

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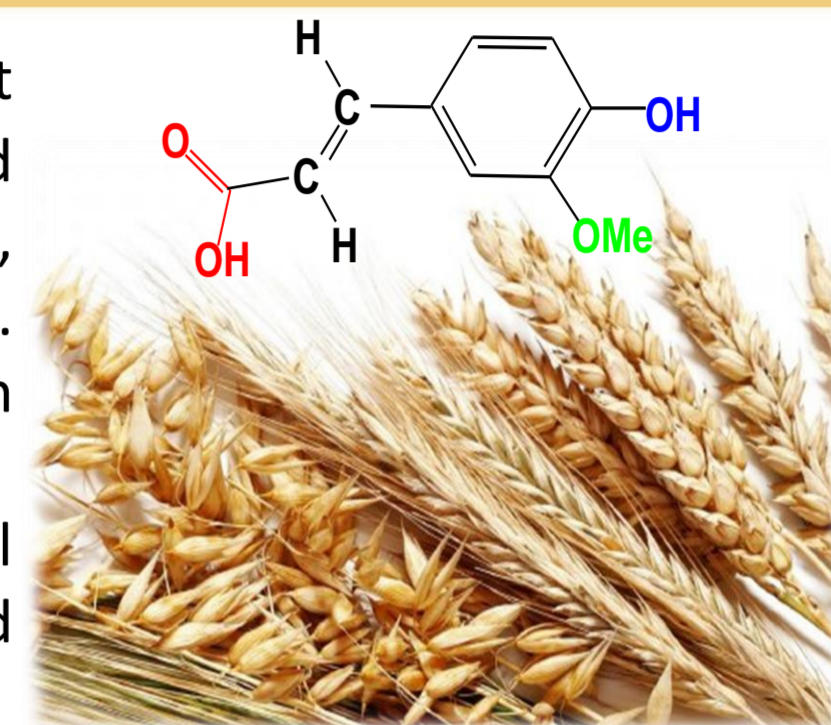
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**INTRODUCTION** Catalytic pyrolysis is one of the most promising methods that can be used to convert lignocellulose, and lignin in particular. Recently, increasing attention has been paid to the use of microwave-assisted catalytic pyrolysis to obtain valuable chemicals from lignocellulosic biomass. This is due to the faster heating rate, precise temperature control, high energy efficiency, and lower temperature gradient heating inherent in this method. The study of the possibility of using microwave (MW) irradiation for the controlled catalytic pyrolysis of lignin monomers in order to obtain certain chemical compounds is also of considerable interest.

In our work, we studied the effect of MW-pretreatment on the decomposition of ferulic acid (FA), as a model compound of lignin, on the surface of nanoscale CeO<sub>2</sub> using FTIR-spectroscopy and temperature-programmed desorption mass spectrometry (TPD MS).

**MATERIALS AND METHODS** The FA/CeO<sub>2</sub> (0,6mmol/g) samples was obtained by impregnation. The samples FA/CeO<sub>2</sub> were irradiated in a MW oven working at 2.45 GHz, for 20 and 300 s. IR spectra were recorded on a Thermo Nicolet Nexus FT-IR instrument. The TPD MS-experiment was performed on an MX-7304 monopole mass spectrometer (Sumy, Ukraine) with electron ionization, reequipped for thermal desorption measurements.



## FT-IR SPECTROSCOPIC STUDIES

Figure 1

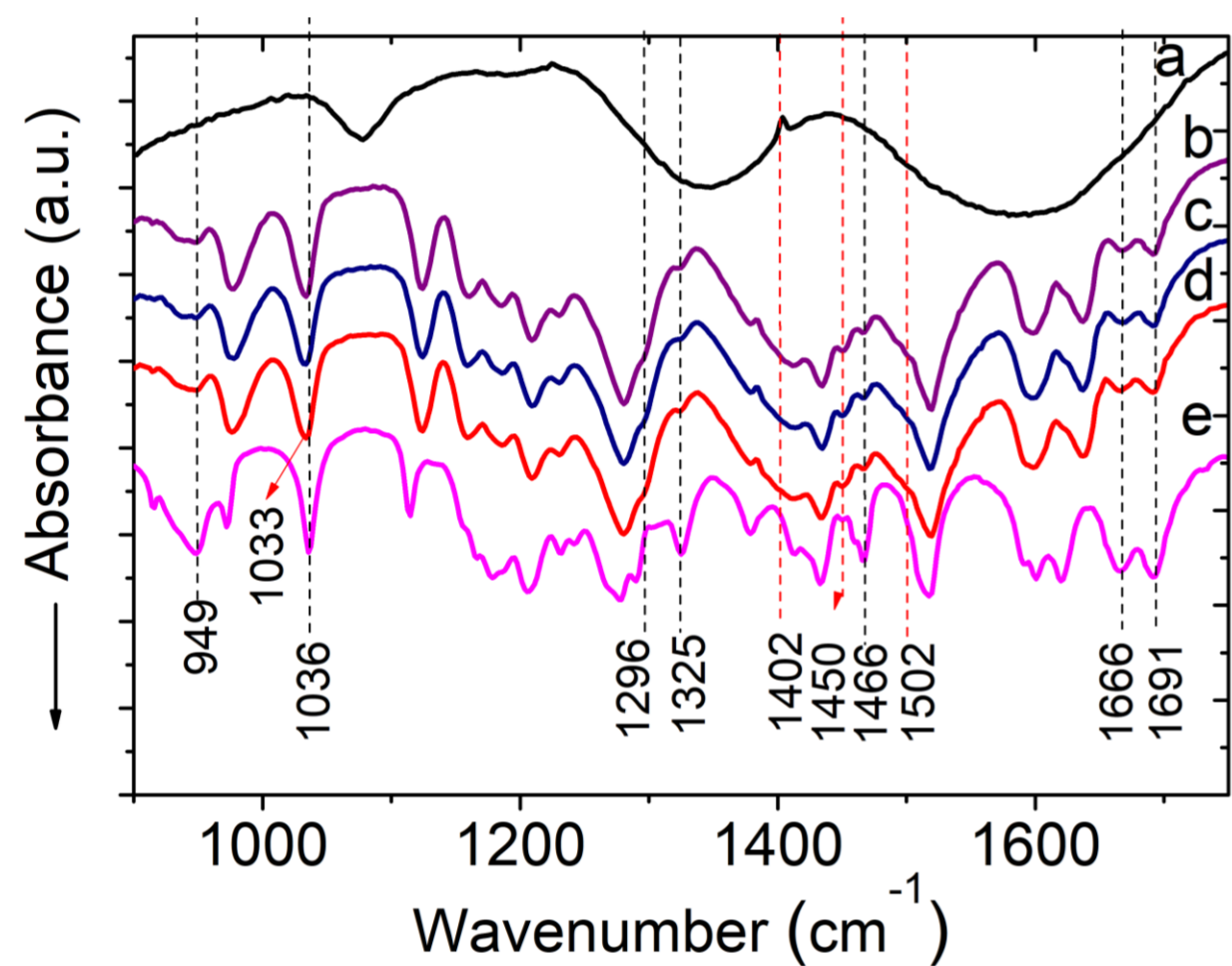
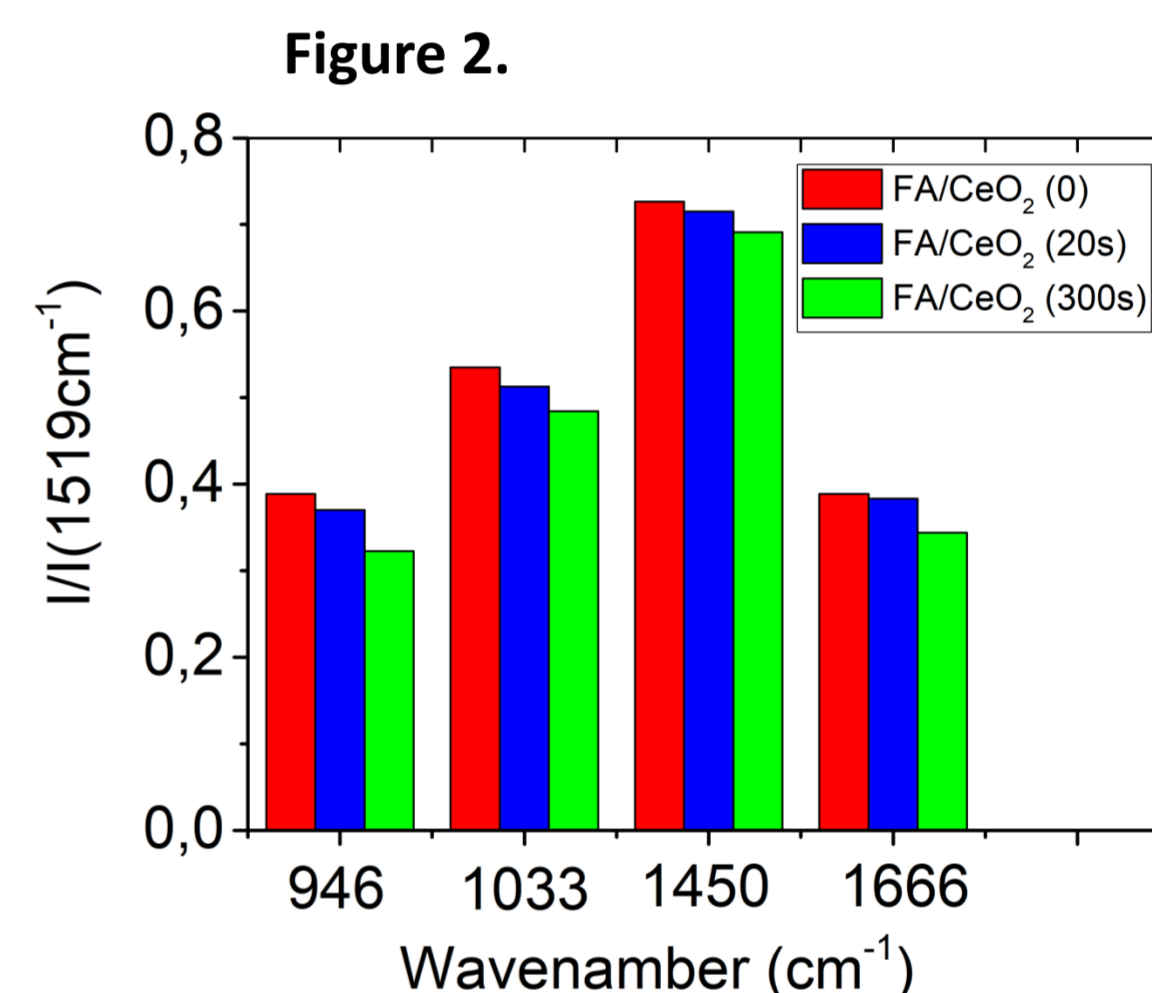


Figure 1. Fourier transform-infrared spectra of pure CeO<sub>2</sub> (a), samples FA/CeO<sub>2</sub> pre-pretreated with MW for 300 s (b), 20 s (c), initial sample of FA/CeO<sub>2</sub> (d) and pure FA (e).

Figure 2. The relative intensity of the main absorption bands of the -COOH -OH and -OCH<sub>3</sub> groups for the IR spectra of initial sample of FA/CeO<sub>2</sub> and samples of FA/CeO<sub>2</sub> pre-irradiated with MW (20 s and 300 s).



## INFLUENCE OF MW-PRETREATMENT ON THE DECARBOXYLATION PROCESS OF FA OVER CeO<sub>2</sub> SURFACE

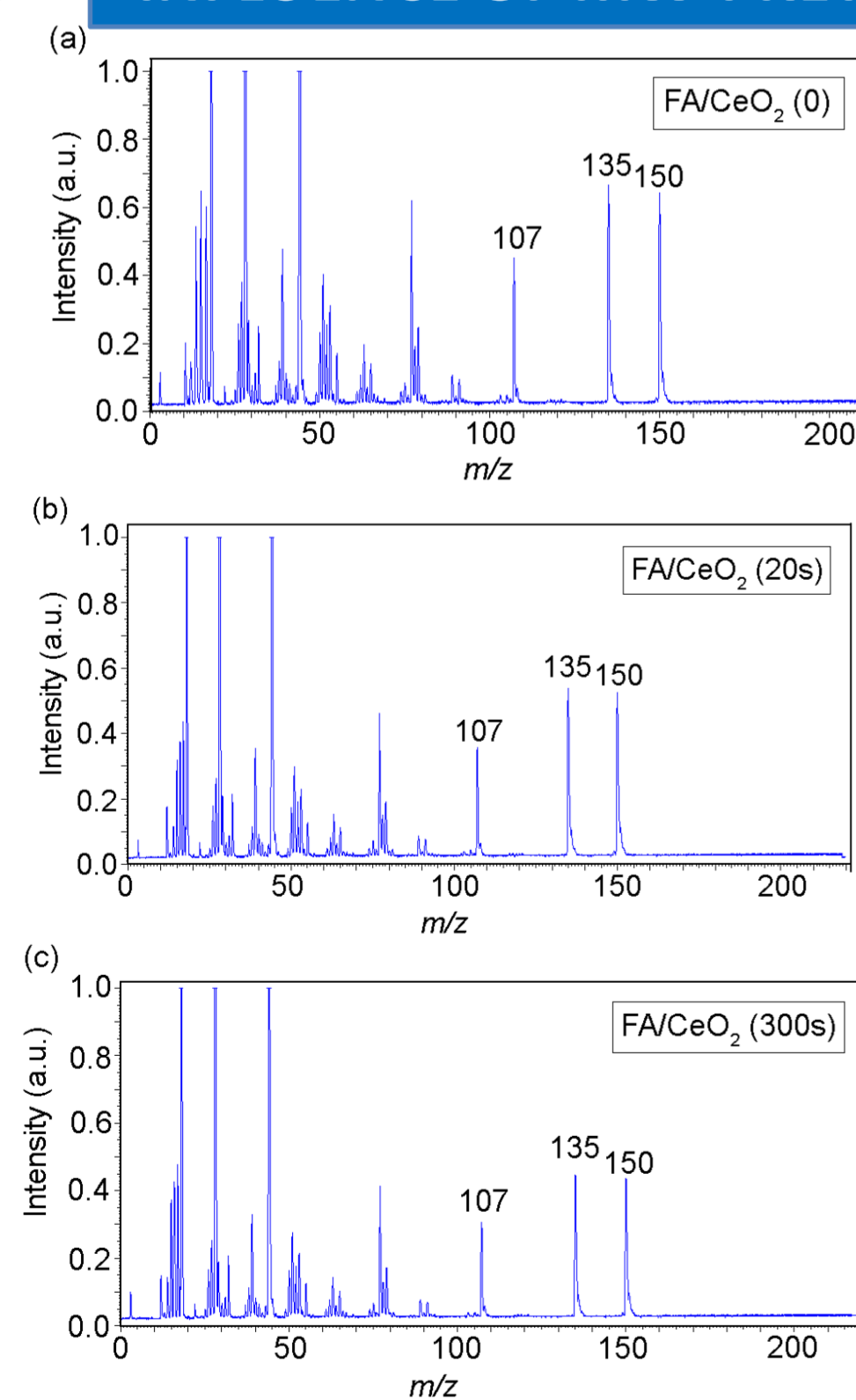


Figure 3. Mass spectra at 120 °C obtained by decomposition of FA/CeO<sub>2</sub> (a) and samples FA/CeO<sub>2</sub> pretreated with MW (b – 20 s, c – 300 s).

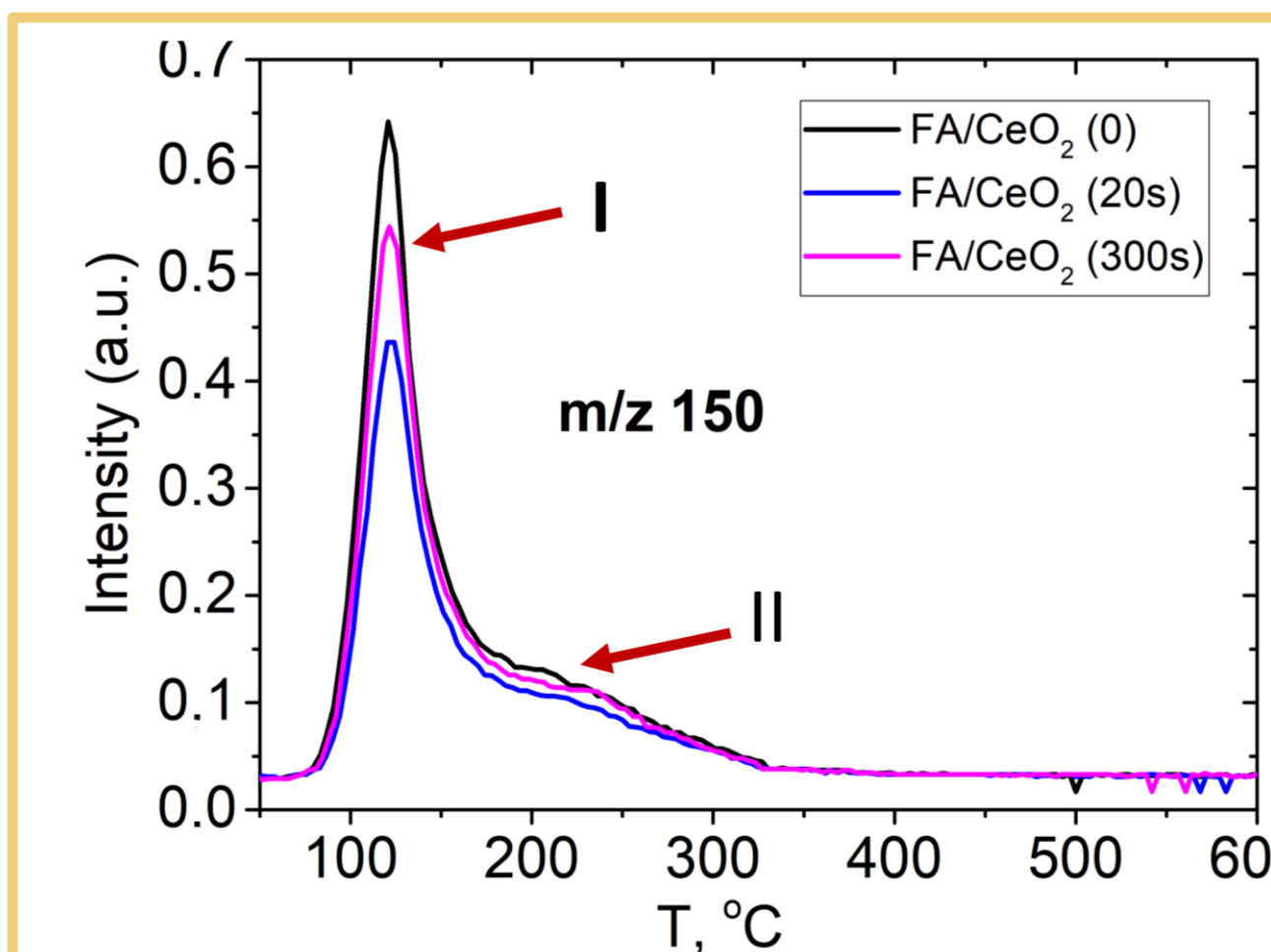
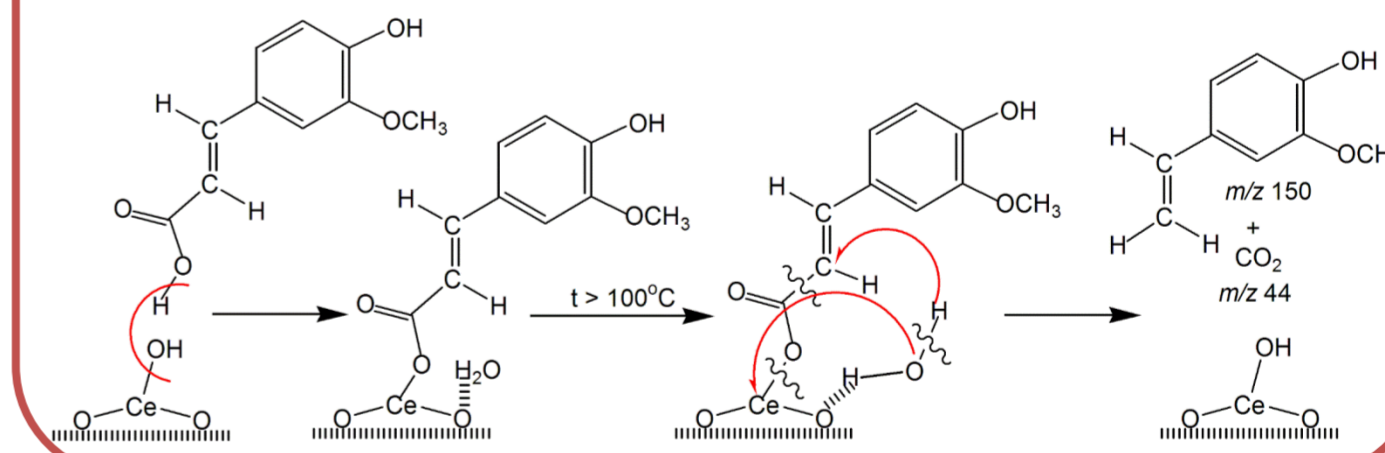
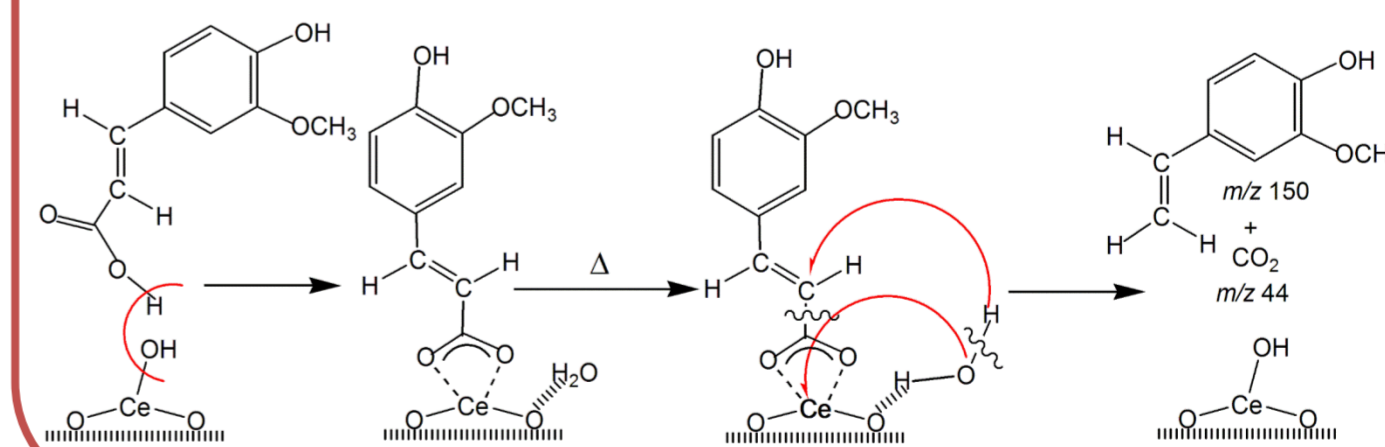


Figure 4. TPD curves for the ion with m/z 150, obtained by decomposing of FA/CeO<sub>2</sub> and samples FA/CeO<sub>2</sub> pretreated with MW for 20 and 300 s.

### I. The decomposition of the monodentate carboxylate complexes of FA [1].



### II. The decomposition of the bidentate carboxylate complexes of FA [1].



**CONCLUSION.** It was found that MW-pretreatment of the FA/CeO<sub>2</sub> samples for 300 s does not lead to a change in the main mechanisms of the thermal decomposition of FA and the formation of new products. Even an insignificant MW-irradiation of FA/CeO<sub>2</sub> for 10 s promotes the decomposition of FA complexes on the CeO<sub>2</sub> surface. Bidentate and weakly bound complexes are more susceptible to the influence of MW-irradiation.

**References.** [1] Nastasiienko N.S., Kulik T.V., Laskin J., Palianytsia B.B., Larsson M., Kartel M.T. Catalytic Pyrolysis of Lignin Model Compounds (Pyrocatechol, Guaiacol, Vanillic and Ferulic Acids) over Nanoceria Catalyst for Biomass Conversion. Appl. Sci. 2021, 11(16), 7205; <https://doi.org/10.3390/app11167205>

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