

Smectite composites for water decontamination from pharmaceutical micropollutants

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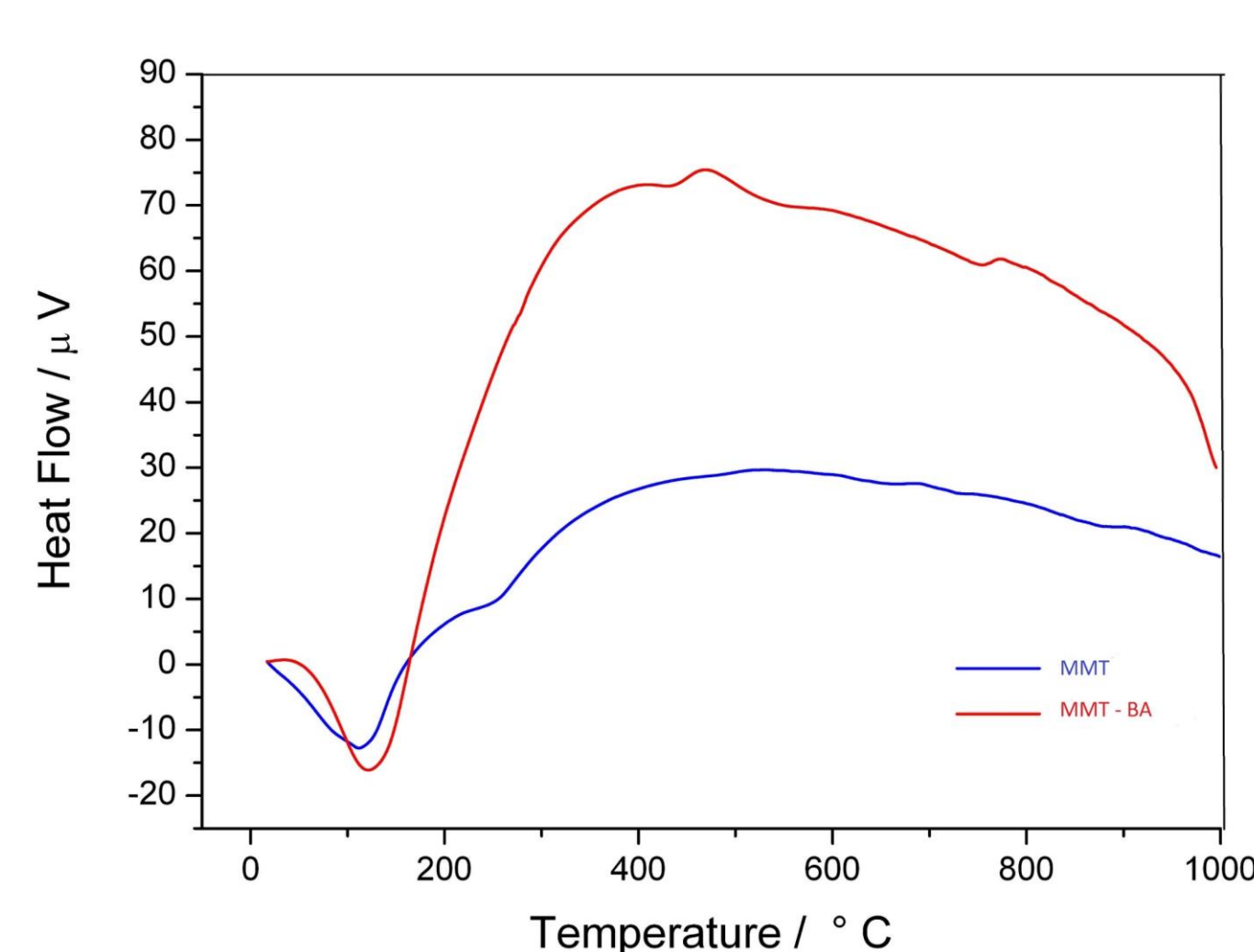
Motivation

- Detection of increasing amount of pharmaceuticals and their metabolites in waste and surface waters
- Pharmaceuticals have been found in almost all environment units on all over the planet in a wide range of concentrations ranging from ng.L⁻¹ to mg.L⁻¹
- Due to the constant increase in their consumption, pharmaceutical residues in water are now called "new alarming pollutants"
- Long-term and harmful effect not only on the environment, but also on the health of people and animals
- Limited possibility of pharmaceuticals removal by existing wastewater treatment processes

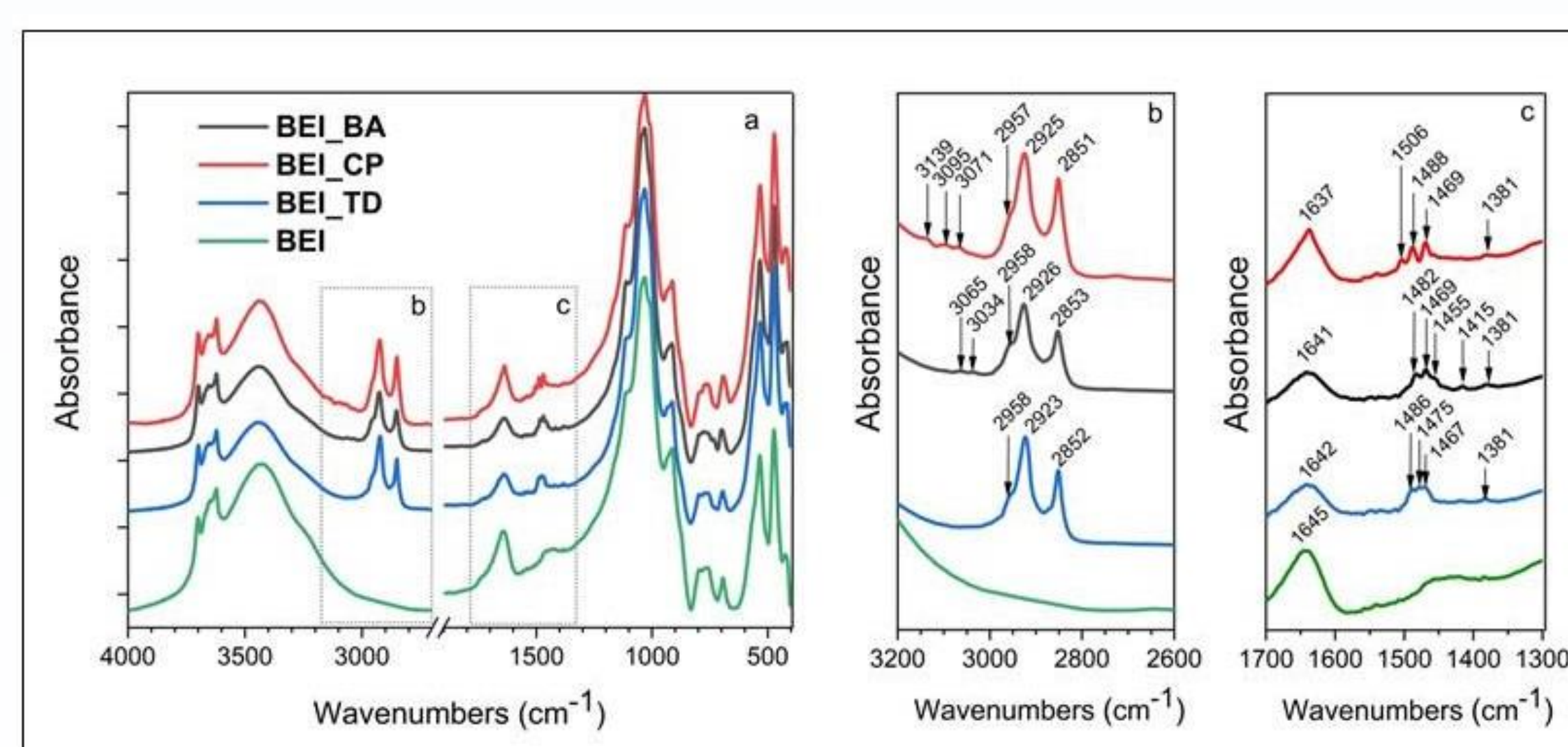
Smectite composites and methods of characterization

Preparation : shaking of 0,1M solution of benzalconium chloride (BA) with pre-treated montmorillonite (MMT), nontronite (NTN), hectorite (HEC) and beidelite (BEI) samples thoroughly for 2.5 h at the room temperature, centrifugation and resuspension in ethanol – water mixture/ethanol, drying at the laboratory temperature

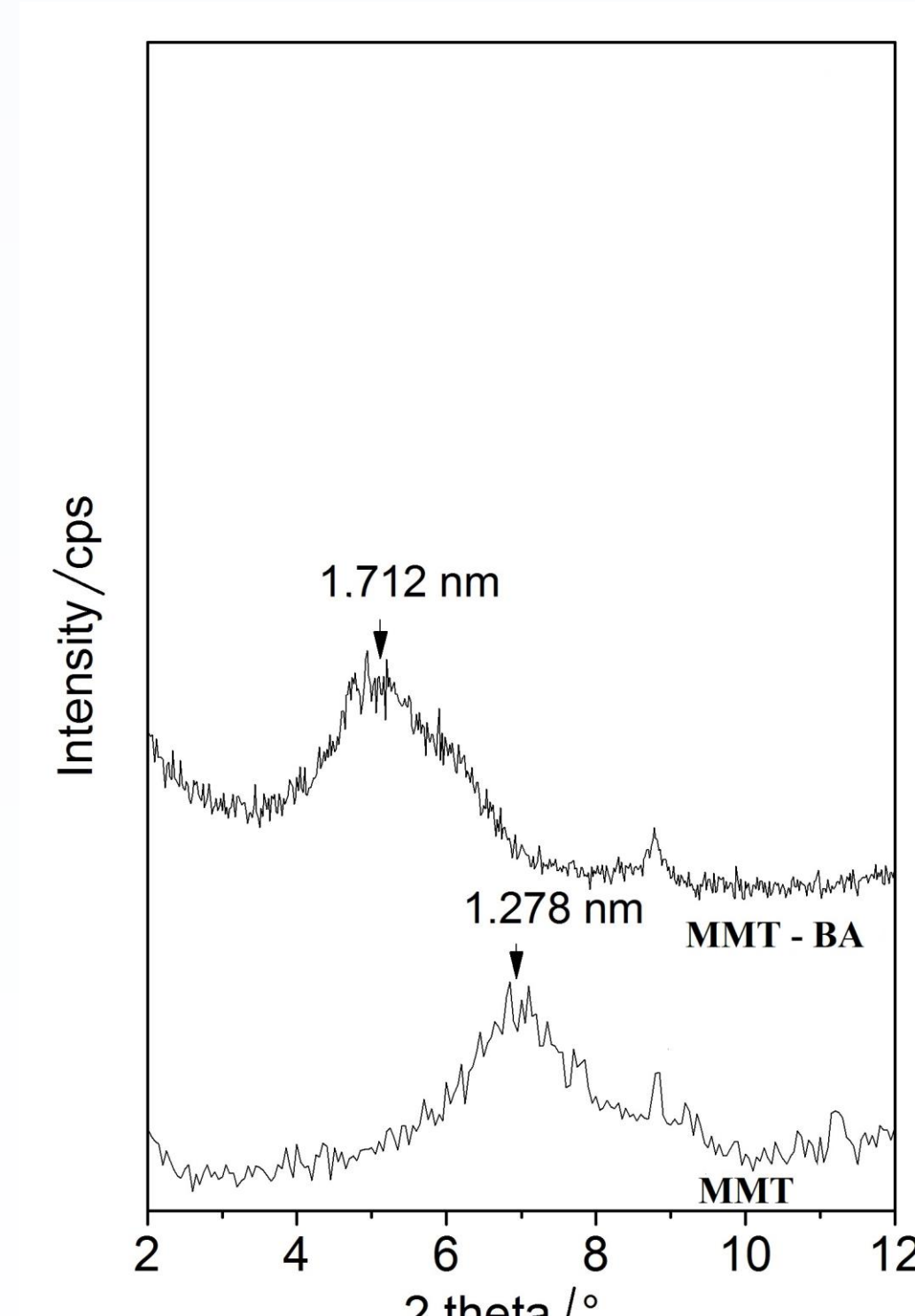
Methods of characterization : XRPD (Ultima IV diffractometer from RIGAKU)
FT-IR spectroscopy (Nicolet 6700 FTIR spectrometer, ThermoScientific)
SEM analysis (TESCAN MIRA 3 FE SEM electron scanning microscope)
TG/DTA (thermal analyzer Setsys 12 Setaram)



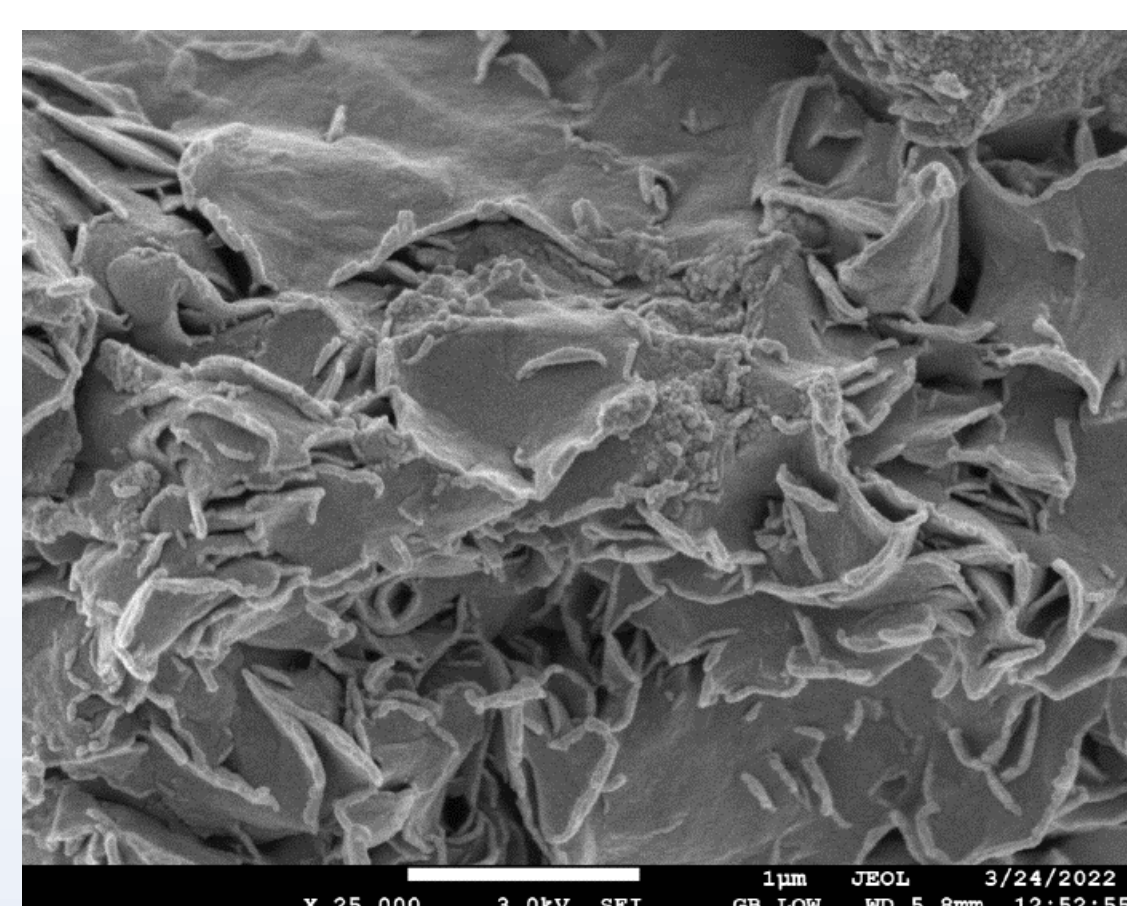
DTA curves of MMT and MMT-BA



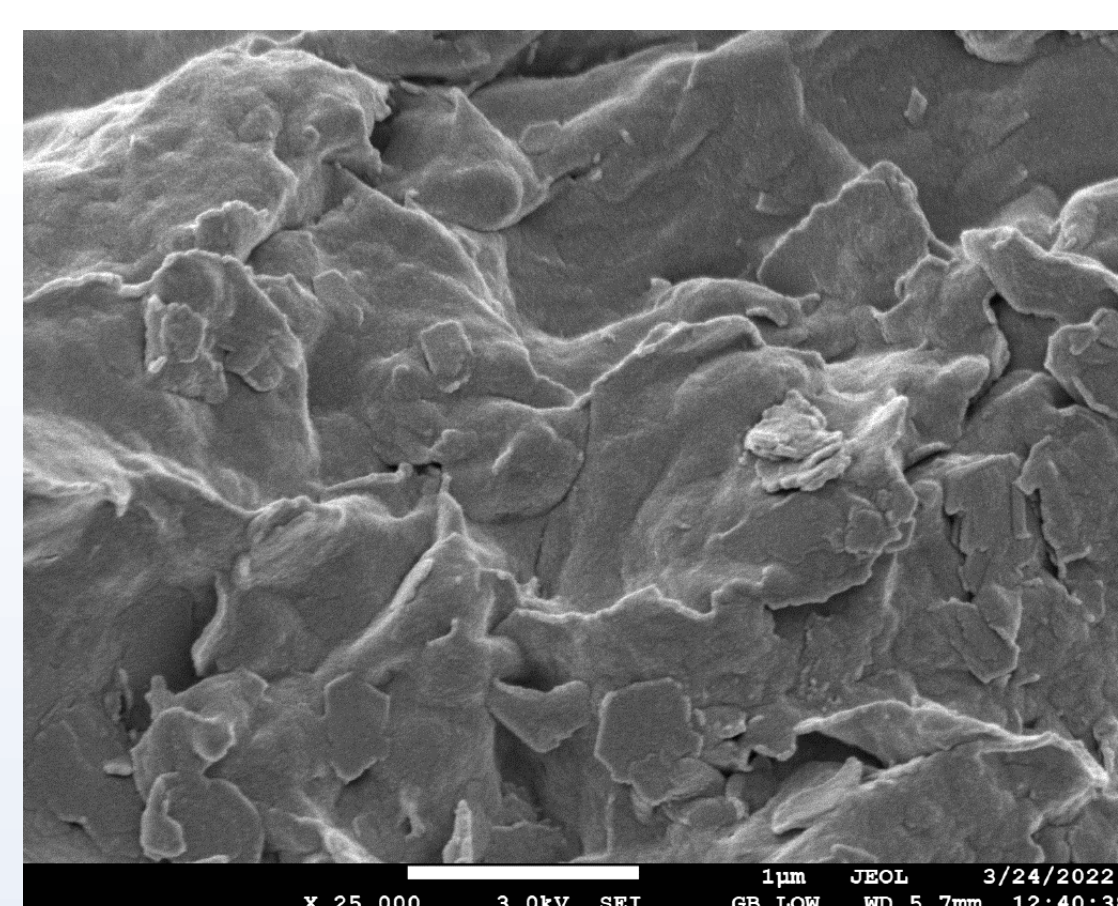
FT-IR spectra of BEI and modified BEI samples



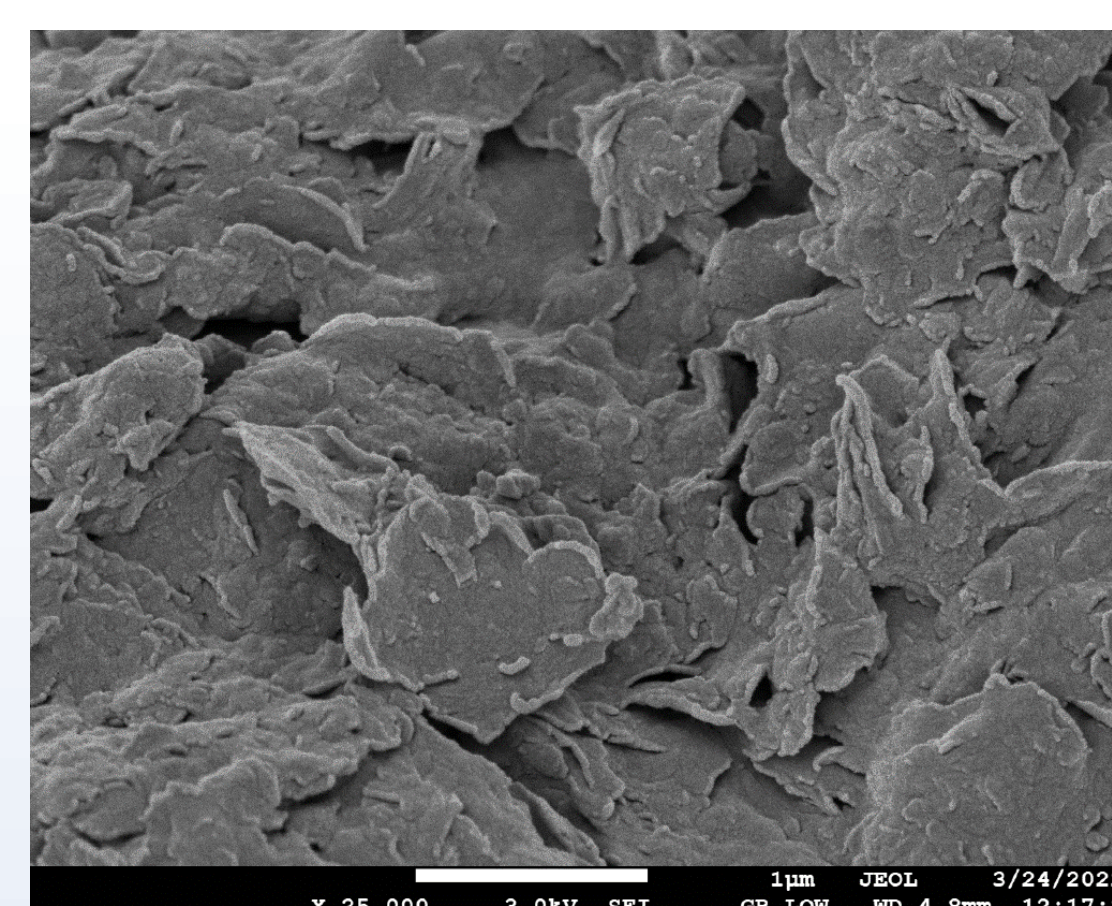
Enhancing of basal spacing values of modified MMT sample from XRD patterns



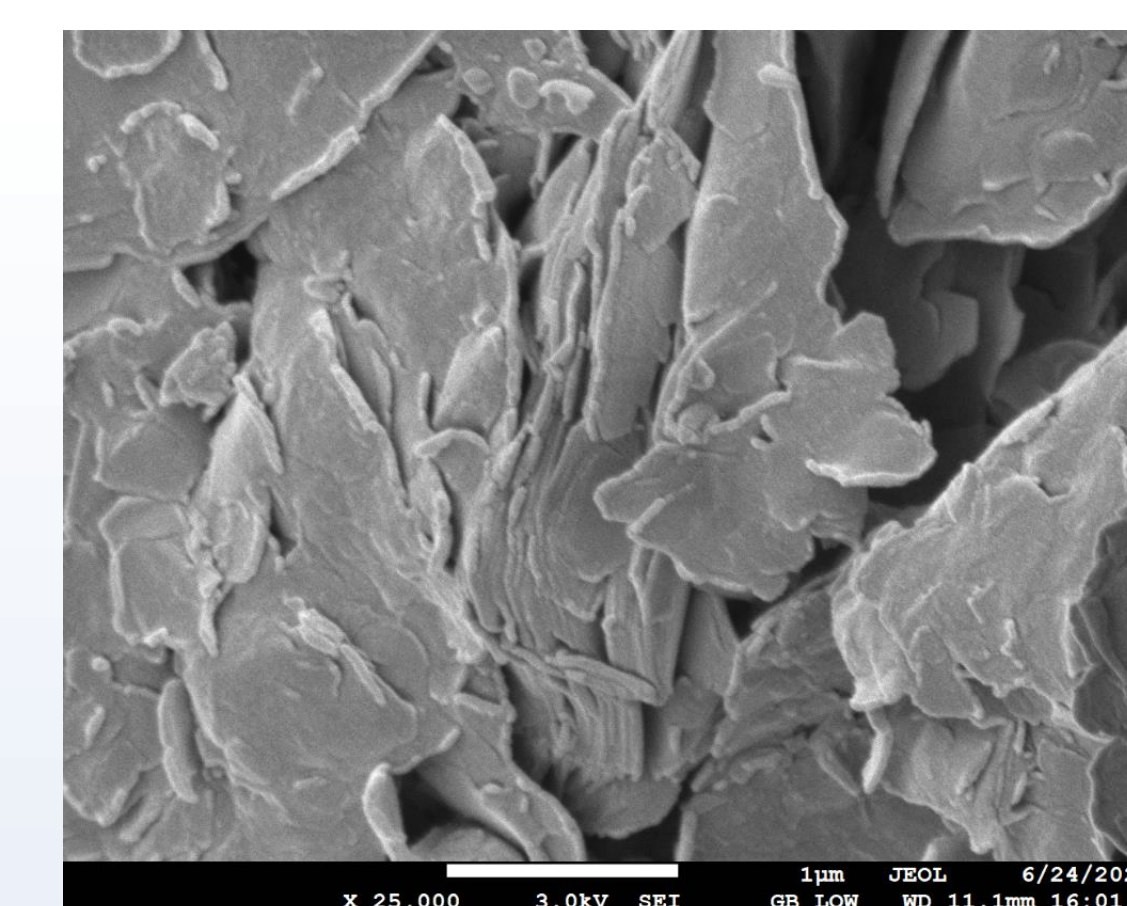
SEM images of the MMT-BA composite



SEM images of the NTN-BA composite



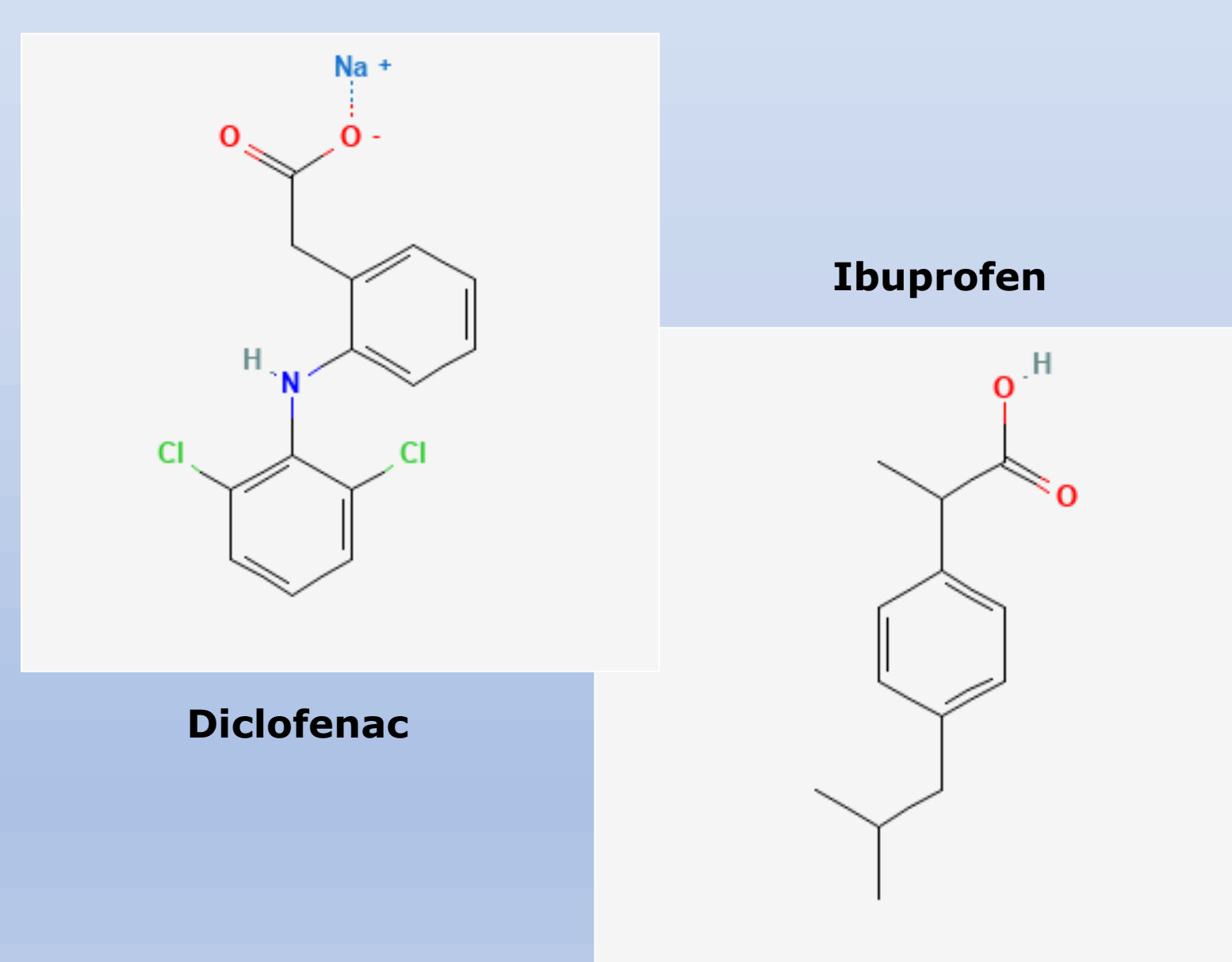
SEM images of the HEC-BA composite



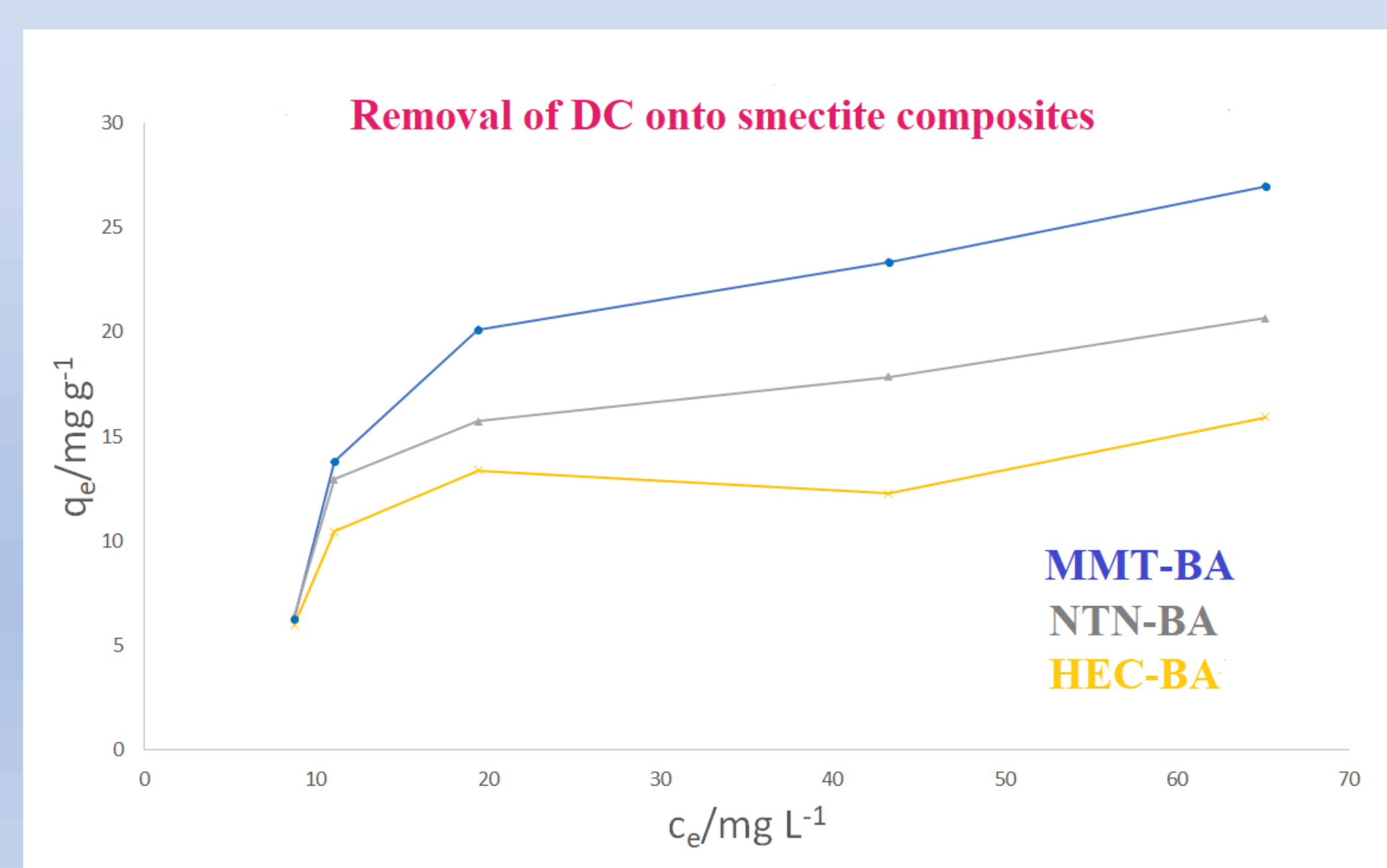
SEM images of the HEC-BA composite

Sorption of diclofenac and ibuprofen

- Adsorption experiments in a batch mode with mass of sorbent 100 mg and volume of diclofenac (DC) or ibuprofen (IBU) solutions 20 mL
- Initial concentrations varied from 40 to 200 mg.L⁻¹
- Sorbent with drug solutions was mixed for 24 hours with following centrifugation and filtration processes
- The amount of DC / IBU was determined using high performance liquid chromatography (liquid chromatograph Waters 2996, Milford)



PubChem - U.S. National Library of Medicine. Available on line:
<https://pubchem.ncbi.nlm.nih.gov> (24 April 2024).



Sorption isotherms for DC onto modified MMT, NTN and HEC



The removal of diclofenac and ibuprofen from aqueous solution reached up to 95% sorption efficiency for all smectite composites in the following order montmorillonite > notronite > beidelitte > hectorite. Generally sorption ability for diclofenac was higher then for ibuprofen.

Acknowledgement

This research was funded by Project of the Czech Academy of Sciences – Strategy AV21 and also supported by Mobility programme of the Czech Academy of Sciences and the Polish Academy of Sciences, Mobility Plus Project, no. PAN-24-22.