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January 21, 2023

Recommendation letter for Anara Omarova's Ph.D. defence

With this letter, I would like to express my strong endorsement of Ms. Anara Omarova's request to defend her Ph.D. dissertation at Al-Farabi Kazakh National University (Almaty, Kazakhstan). I have served on Anara's Ph.D. committee as her External Co-supervisor since 2018.

Anara's primary research objective was to develop and improve methods for *in situ* growth of solid-phase microextraction coatings based on metal-organic frameworks to analyze VOC in air samples. VOCs are merging air pollutants. Therefore, her contribution to the field is significant. Although developing new fibres for pollutant quantification in environmental samples is challenging, she successfully developed new MOF-based SPME fibres. Her work resulted in an efficient sampling and measurement method for VOC in air. Air pollution is a mounting problem worldwide, and using Anara's optimized MOF-based SPME fibres will be greatly beneficial in investigating VOCs in air samples that negatively impact humans and the environment.

During her Ph.D., Anara visited UNBC to conduct part of her project in the Northern Analytical Laboratory Service (NALS). Anara's solid academic background helped her to learn quickly. She has demonstrated the ability to work independently with great creativity and enthusiasm. She completed all planned works successfully during her short time as a visiting

scholar at UNBC. As a result of her Ph.D. works, Anara published the following

three manuscripts in high-impact factor journals:

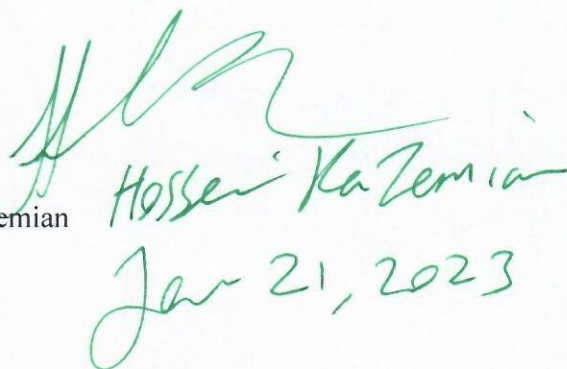
- 1- A Omarova, N Baimatova, H Kazemian , MOF-199-based coatings as SPME fiber for measurement of volatile organic compounds in air samples: Optimization of in situ deposition parameters, *Microchemical Journal* (2023), 185, 108263 (**IF:5.3**)
- 2- A Omarova, NV Bakaikina, A Muratuly, H Kazemian, N Baimatova , A review on preparation methods and applications of metal–organic framework-based solid-phase microextraction coatings, *Microchemical Journal* (2022), 175, 107147 (**IF: 5.3**)
- 3- A Omarova, A Baizhan, N Baimatova, B Kenessov, H Kazemian , New in situ solvothermally synthesized metal-organic framework MOF-199 coating for solid-phase microextraction of volatile organic compounds from air samples, *Microporous and Mesoporous Materials* (2021), 328, 111493 (**IF: 5.87**)

Furthermore, she presented her works at several national and international conferences such as International scientific conference for students and young scientists "FARABI ƏLEMI" (Kazakhstan, 2019), International Chemical Engineering Symposia (Japan, 2020) and the XXIII International Symposium on Advances in Extraction Technologies (ExTech, June 29 - July 2 2021, Spain).

Overall, I am very pleased with Anara's achievements and accomplishments during her Ph.D. program, and I firmly believe her substantial research work qualifies her to earn her Ph.D. in Chemistry.

Sincerely,

Hossein Kazemian



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