Development of an *in situ* K-Ar dating technique using LIBS-QMS combination

Y.CHO[1]*Y. N. MIURA[2] AND S. SUGITA[3]

[1]Dept. Earth & Planetary Scientce, University of Tokyo, Kashiwa, Chiba, 277-8561 Japan
(*correspondence: cho@astrobio.k.u-tokyo.ac.jp)
[2]Earthquake Research Institute, Univ. Tokyo 113-0033 Japan
[3]Dept. Cmplx. Sci. & Engr., Univ. Tokyo, Chiba 277-8561, Japan

The age of a rock is one of the most critical parameters for understanding the nature of the sample. Age determination of some key samples not only reveals the history of the specific rocks but also enables us to determine the age of planetary surfaces. In fact, absolute age determination of the planetary surfaces relies on the correlation between crater number density and the ages obtained by Apollo and Luna missions (chronology function) [1]. However, the chronology curve has a 0.5-1 Gyr of uncertainty due to the lack of returned samples. Determining the shape of the chronology function is important not only for determining accurate age, but also for understanding the temporal variation of the impact flux to the Earth-Moon system. In-situ age measurements and/or sample-return mission(s) are crucial to resolving this problem.

We have been developing an in-situ dating method using K-Ar system for future planetary landing missions on the Moon or Mars. In our method, K and Ar in a sample are extracted by the laser ablation and measured with laser-induced breakdown spectroscopy (LIBS) and a quadrupole mass spectrometer (QMS) as well as an optical microscope to measure the volume of laser ablation pits [2, 3].

Using our instrument we obtained the model ages of three previously measured samples with known K concentrations and ages: 2.1±0.3 Ga for a hornblende (K_2O=1.12 wt%, 1.75 Ga), 1.8±0.2 Ga for a biotite (K_2O=8.44 wt%, 1.79 Ga), and 2.0±0.3 Ga for a plagioclase (K_2O=1.42 wt%, 1.77 Ga). Since the three samples have similar ages and different K concentrations, we should be able to construct a “virtual” isochron by plotting the concentrations of K and radiogenic ^{40}Ar. The slope of the isochron simulated with our experimental data yields 1.78 Ga of age. This value is in good agreement with known values of 1.79 Ga.

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Functionalized Carbon Nanotube for Forward Osmosis Membrane: Fabrication and Desalination Application

HYEON-GYU CHOI[1] MOON SON[1] HOSIK PARK[1] AND HEECHUL CHOI[1]*

[1]School of Environmental Science and Engineering, Gwangju Institute of Science and Technology, 1 Oryong-dong, Buk-gu, Gwangju, Republic of Korea (hgstyle@gist.ac.kr, moons@gist.ac.kr, phosik@gist.ac.kr)
*(correspondence: hcchoi@gist.ac.kr)

Forward osmosis (FO) has huge potential to replace with reverse osmosis due to the fact that it operates with osmotic pressure difference and low fouling tendency [1]. In this study, we synthesized the functionalized carbon nanotube blended polymeric membrane and evaluated performance for desalination application. Firstly multi-walled carbon nanotubes (MWCNTs) were functionlized by acid treatment [2]. By blending the MWCNTs, cellulose acetate based composite membrane was synthesized using phase inversion [3]. To characterize the MWCNTs and the membrane, SEM, TEM, FT-IR, and contact angle measurement were utilized. Lab-scale forward osmosis system was operated to evaluate membrane performance for desalination application.

It was confirmed that the functionalized MWCNTs has carboxylic group by acid treatment [3]. The hydrophlic group increase the hydrophilicity of the membrane resulting in enhanced water permeated flux. After 6 hours operation of lab-scale FO system, 47% of water permeated flux increased by 1% CNT blended. Salt ion rejection was not hindered by the presence of CNT (99% when 0% CNT and 97% when 1% CNT blended repectively), marginal reduction in salt rejection was caused by thinner membrane thickness due to increased viscosity of the polymer solution by CNT blending [4],[5]. Even small amount of MWCNTs was blended (i.e., 1 wt%), water permeated flux dramatically incresased whereas the salt ion rejection of the membrane was not decreased much compared to bare cellulose acetate membrane. This study showed the capability of MWCNTs to increase forward osmosis membrane performances for desalination application.

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