油–鉱物–水システムにおける濡れ性に関する研究

―ミクロスケールでの接触角の測定―

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Contact Angle Measurement for Oil–Mineral–Water System on a Micro Scale

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Abstract

Enhanced Oil Recovery (EOR) is used to increase the production of oil from geological reservoirs. EOR technology often involves injecting water into rock formations to recover oil remaining in rock pores. Therefore, an evaluation of the wettability of the oil–mineral–water 3-phase interfacial system is needed. In particular, the contact angle of water on the mineral surface in the presence of oil is the essential parameter governing wettability. In this study, the contact angles in the decane–muscovite–water interfaces were measured using an Atomic Force Microscope (AFM). The topologies of small water droplets (mostly less than 15 μm) in a liquid decane solution on muscovite plates were acquired with an AFM. The height and contact width obtained from the profiles of small droplets provide the contact angles between decane–muscovite–water interfaces. To correct for the effect of scanning pressure on topologies, contact angle measurements were carried out at different scanning pressures and force curves were measured on the decane–water interface. The corrected contact angles of water droplets showed around 20 degrees over a contact width of about 6 μm, which were in agreement with macroscopic contact angle data, while they decreased to about 15 degrees at a smaller contact width than about 2 μm. The relationship between corrected contact angles and droplet sizes is explained well by the modified Young's equation with a line-tension force of -2.1×10^{-9} N. The results indicate that the wettability of oil–mineral–water interfaces differs between nano/micro scale and macro scale. Therefore, microscopic wettability should be considered when evaluating EOR in real rock systems.

Key words：　wettability, contact angle, Young's equation, oil–mineral–water, atomic force microscope

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