

New Apparatus for Measuring Interfacial Properties of Fluids at Reservoir Conditions

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Interfacial phenomena are ubiquitous not just in the chemical engineering field, but also in hydrogeology and biotechnology. The efficiency of processes such as enhanced oil recovery (EOR) and carbon capture and storage (CCS) relies greatly on a thorough understanding of interfacial properties such as interfacial tension (IFT) and contact angles (CA) between fluids and solid surfaces. It is already known that factors such as temperature, pressure, and concentration (i.e. for saline solutions and/or systems containing supercritical CO₂) have significant effects on interfacial properties and thus affect the fluid flows and ultimately the effectiveness of processes such as EOR and carbon storage. Currently there are many experimental techniques used to investigate interfacial properties and, for high-pressure high-temperature (HPHT) conditions, those most commonly employed are the pendant drop and the sessile drop methods using drop shape analysis (DSA). To date, the main concern regarding the data already existing in the literature, for example for CA of CO₂-H₂O/brines-quartz systems is in relation to their very large scatter even at similar/identical conditions. In addition, reliable data for more challenging systems that present greater difficulty in measuring such as CO₂-H₂O/brines-calcite are very scarce. In this work, we present the design, set up and validation of a new apparatus capable of measuring CA at reservoir conditions even for more challenging systems such as CO₂-H₂O/brines-calcite. The acquisition of reliable data for this type of system could help facilitate the further development of carbon storage technologies.