Interfacial Tensions of (CO_2 + H_2O + N_2 or Ar or H_2) at Temperatures of (298 to 473) K and Pressures up to 50 MPa

Y. T. Florence Chow [S], Geoffrey C. Maitland and J. P. Martin Trusler [C]
Qatar Carbonates and Carbon Storage Research Centre, Imperial College London, London, United Kingdom
m.trusler@imperial.ac.uk

Interfacial tension measurements of the (CO_2 + H_2O + N_2 / Ar / H_2) and (N_2 / Ar / H_2 + H_2O) systems are reported at pressures of (2 to 50) MPa, and temperatures of (298.15 to 473.15) K. The pendant drop method of imaging a fluid-saturated pendant water drop, surrounded by a water-saturated fluid phase in a high-pressure view cell, is used. In this method, it is necessary to know the density difference between the two phases. To permit calculation of this difference, the compositions of the coexisting phases are first computed from a combination of the Peng-Robinson equation of state (applied to the non-aqueous phase) and the NRTL model (applied to the aqueous phase). Densities of the non-aqueous phase are computed from the GERG-2008 equation of state, while those of the aqueous phase are calculated knowing the partial molar volumes of the solutes. The expanded uncertainties at 95 % confidence are 0.05 K for temperature, 0.07 MPa for pressure. The interfacial tensions in all systems are found to decrease with both increasing pressure and increasing temperature. Empirical correlations are developed for the interfacial tension of the (N_2 / Ar / H_2 + H_2O) systems in the full range of conditions investigated, and these are used to facilitate a comparison with literature values. Estimates of the interfacial tension for the ternary systems, by means of empirical combining rules based on the coexisting phase compositions and the interfacial tensions of the binary sub-systems, are found to be somewhat inadequate at low temperatures.

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