

Surface energy of fayalite and its effect on Fe-Si-O oxygen buffers and the olivine-spinel transition

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The surface energy (hydrated surfaces) of fayalite Fe_2SiO_4 was determined to be $2.47 \pm 0.25 \text{ J/m}^2$ using high temperature oxide melt solution calorimetry. This is larger than the surface energy of Fe_3O_4 spinel, but lower than that of forsterite Mg_2SiO_4 . The changes in the positions of the quartz/fayalite/magnetite (QFM) and quartz/iron/fayalite (QIF) buffers with particle size reduction were calculated. QFM is lowered in $f\text{O}_2$ by 3-7 log units as a function of temperature for 30 nm particles while QIF is raised by 1-2 log units. The estimated surface energy difference between olivine and spinel polymorphs decreases the pressure of the olivine-spinel transition in Fe_2SiO_4 by about 1 GPa.