American Mineralogist, Volume 96, pages 1461–1466, 2011

Zeolitic-type Brønsted-Lowry sites distribution imaged on clinochlore

Giovanni Valdrè,[1,*] Sergio Tosoni,[2] and Daniele Moro[1]

[1]Dipartimento di Scienze della Terra e Geologico-Ambientali, Università di Bologna, Piazza di Porta San Donato 1, Bologna I-40126, Italy
[2]Institut für Chemie, Humboldt-Universität zu Berlin, Unter den Linden 6, Berlin 10099, Germany

Abstract

Although Brønsted-Lowry (B-L) sites in solids, such as zeolites, have been studied extensively, all previous investigations were conducted on a bulk (average) basis. In contrast, the imaging and distribution of B-L sites on atomic flat Al-rich chlorite are presented by using Scanning probe and Kelvin probe force microscopy. These techniques are used to correlate, at the nanoscale, the contrast due to the surface potential (related to the B-L proton) with the surface morphology and crystal chemistry. Quantum mechanical modeling (DFT) is consistent with the experimental results.

Imaging of the distribution of B-L sites in solids and the existence of two-dimensional (2D) arrays of zeolitic-type B-L sites in chlorites is shown. The study demonstrates the general validity of the Brønsted-Lowry acid-base theory extended to pure solids without any solution medium. The experimental approach developed here can facilitate the search of B-L site architectures in minerals.

Keywords: Brønsted-Lowry sites, chlorite, zeolite, Kelvin probe, quantum mechanical modeling