Nature of five-coordinated aluminum on ?-Al2O3 surface
1 June 2022, by Li Yuan

?-Al2O3, an important catalyst and catalyst support, is widely used in various industrial applications. The five-coordinated aluminum, or Al(V), on the surface of ?-Al2O3 can affect the catalytic performances of ?-Al2O3.

Recently, a research team led by Prof. Hou Guangjin from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS), in collaboration with Dr. Gan Zhehong from the National High Magnetic Field Laboratory, for the first time observed the structure of Al(V) on the surface of ?-Al2O3 using ultrahigh-field (1.5GHz) solid-state Nuclear Magnetic Resonance (NMR) spectroscopy.

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The researchers investigated the structural properties of commercial ?-Al2O3 and amorphous alumina nanosheets (Al2O3-NS) rich in Al(V) by ultrahigh-field multinuclear and multi-dimensional Magic Angle Spinning (MAS) NMR.

They analyzed the aluminum species in both aluminas and found the flexible structural features on the surface of Al2O3-NS. And they demonstrated the hydroxyl groups on the surface of ?-Al2O3 with close spatial proximity that were able to be removed under high-temperature dehydration, resulting in surface structure reconstruction.

Moreover, by using ultrahigh-field 27Al-27Al double-quantum NMR, the researchers for the first time revealed that most Al(V) species tended to aggregate into Al(V) domains on the surface of ?-Al2O3 like Al2O3-NS, rather than tetragonal pyramid coordination on (100) surface previously predicted from theoretical models.

"These new insights into surface Al(V) species would help us to better understand the structure and function relationship of ?-Al2O3 when used as catalysts and catalyst supports," said Prof. Hou.


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