

Chemical evolution in molecular clouds by surface atomic reactions at low temperatures

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Chemical reactions on the surface of icy grains play an important role in chemical evolution in interstellar molecular clouds. Among many kinds of molecules observed, the abundances of some major species such as H₂O, H₂CO and CH₃OH can not be explained by gas-phase synthesis and so surface reactions on dust grains are required for such molecules. To understand the formation mechanism by surface atomic reactions involving H and O atoms and CO molecule, we experimentally investigated reactions of cold H atoms with solid CO or O₂ molecules at 8-40 K. We found that hydrogenation of CO and O₂ proceed very efficiently to form H₂CO and CH₃OH, and H₂O, respectively. Based on the reaction rates obtained we discuss the reaction mechanism. Furthermore, we clarified that the structure of water ice formed is amorphous, which is consistent with the astronomical observation.