From Interstellar Ices to PAHs

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INVITED TALK

H_2 formation on PAHs: a high temperature pathway to molecular hydrogen

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Molecular hydrogen is the most abundant molecule in the Universe. Next to dust, polycyclic aromatic hydrocarbons (PAHs) can be important catalysts to the formation of H_2. The presence of pre-adsorbed H atoms on PAHs increases the yield of H_2 formation by many orders of magnitude, rendering this process an important route towards molecular hydrogen formation in the interstellar medium (Bauschlicher 1998). We showed that for coronene cations as prototypical PAH, hydrogenation follows a site-specific sequence leading to the appearance of stable cations having 5, 11, or 17 hydrogen atoms attached, that we refer to as magic numbers. For these stable cations, further hydrogenation requires appreciable structural changes associated with a high transition barrier. The occurrence of stable superhydrogenated PAHs is fundamental to identify hydrogenated PAHs in space and assess their contribution to the formation of H_2.

In order to determine the influence of PAHs on the total H_2 formation rate in photodissociation regions (PDRs), we developed a chemical model and determined the chemical composition at different depths of the PDR (Boschman et al. 2015). Since H_2 formation on PAHs is impeded by thermal barriers, this pathway is only efficient at higher temperatures (T$\geq$ 200 K). At these temperatures the conventional route of H_2 formation via H atoms physisorbed on dust grains is no longer feasible, but the mechanism involving PAHs enlarges the region where H_2 formation is efficient. We find that PAHs have a significant influence on the structure of PDRs since the transition from atomic to molecular hydrogen strongly depends on their presence, especially for PDRs with a strong external radiation field. Our results show that H_2 can form very efficiently on PAHs, and that this process can reproduce the high H_2 formation rates derived in several PDRs (Habart 2005).

REFERENCES

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