Methane conversion to higher hydrocarbons in microwave plasma

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Methane conversion to higher hydrocarbons (C2 and above) was investigated in a microwave plasma reactor. The chemistry that needs to be studied in order to understand the conversion process is very similar to the chemical processes that are thought to take place in the stratospheres of reducing planetary atmospheres. That is plasma is formed by lightning, the plasma is rapidly quenched when the lightning extinguishes to form more complex molecules, than the atmosphere originally contained.

In this study, thermodynamic equilibrium and kinetic modelling simulations were carried out and it was shown that plasma processes can be modelled accurately by detailed reaction kinetic models, however thermodynamic models apply only at high temperatures (above 2000 K). It was shown that the conversion of methane to higher hydrocarnons is possible in microwave plasma, and the main products are C_2H_2, C_2H_4 and C_6H_6.

Kinetic analysis was carried out by investigating the atom fluxes and the importance of reactions. Flux analysis revealed the change of inter-conversion rates among species during the process. As a conclusion, original kinetic mechanisms could be significantly reduced.