Applying network analysis to plasma data; the analysis of relations through mathematical graphs

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Low-temperature plasma science is an interdisciplinary research field spreading over physics, chemistry and biology. Understanding and predicting the plasma-induced chemistry emerged from the interaction with ambient air, liquid and/or biological substrates is becoming increasingly important. The complex reaction system initiated by energetic electrons (up to several eV in general) consists of noble gas, oxygen, nitrogen, carbon, water vapour and its intermediates, such as radical species and reactive species.
In this work, the graph theory is applied to visualize the topology of plasma-induced chemistry and to analyze the network centrality*. The topological visualization suggests that the plasma-induced chemistry is complicated enough to form a web-like network rather than a random network. The directed graph diagram weighted by the centrality identifies the species which play important roles to trigger subsequent reactions and to bridge sources and products directly or indirectly.

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[*] A degree centrality (a number of the direct connection to the others) and a betweenness centrality (a ratio between the number of shortest directed paths passing through a given node and that of all the directed shortest paths) are powerful indicators to look inside of the network structure.