# FT-ICR Study of Reaction Induced Fragmentation of Silicon Clusters with Nitric Oxide

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Chemical reaction of small silicon cluster ions ($Si_n^+$: $20 \le n \le 29$) with nitric oxide was studied by using the FT-ICR (Fourier Transform Ion Cyclotron Resonance) mass spectrometer. Silicon clusters were generated by a pulsed laser-vaporization supersonic-expansion cluster beam source directly connected to the FT-ICR mass spectrometer. Injected and size selected clusters were thermalized to the room temperature through collisions with argon, and were exposed to the reactant gas, nitric oxide, in the ICR cell. Results of reaction for all size tested ($20 \le n \le 29$) are summarized in Fig. 1. For Si clusters larger than $Si_{24}^+$, an extraction reaction of a silicon atom was observed as follows: $Si_n^+ + NO \rightarrow Si_{n-1}N^+ + SiO$. On the other hand, small size clusters (except for $Si_{21}^+$) were more complicated. They were broken into smaller pieces. After the same reaction as larger clusters, resulting $Si_{n-1}N^+$ further fragmented into smaller clusters probably due to the exothermic reaction energy. For a comparison, laser induced fragmentation experiments of size-selected clusters were performed. The fragmentation patterns of $Si_{n-1}N^+$ were similar to photo-fragmentation patterns of $Si_{n-1}^+$ cluster, but more selective number of daughter ions. It was suggested that this reaction-induced fragmentation experiments could be regarded as the threshold fragmentation experiments and gave much information about the original structure and binding energy of small silicon clusters. Furthermore, the specialty of $Si_{21}^+$ and the sudden change of reaction pattern between $Si_{23}^+$ and $Si_{24}^+$ may be related to the change in geometric structure of silicon cluster around 25 size suggested by the ion drift experiment [R. R. Hudgins et al., J. Chem. Phys., 11-17, (1999), 7865.].

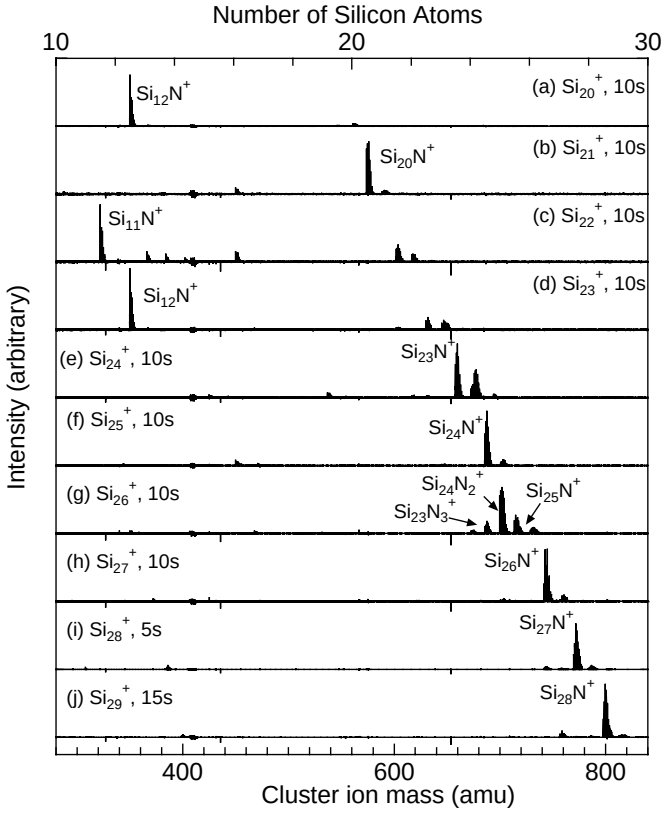


Fig. 1 Chemical reaction products of size selected silicon clusters $Si_n^+$ ($20 \le n \le 29$) with nitric oxide at $1 \times 10^{-6}$ Torr.