Does N$_2$O react over oxygen vacancy on TiO$_2$(110)?

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Molecular N$_2$O has been known to react over oxygen vacancy on a reduced rutile TiO$_2$(110)-1$\times$1 surface to desorb as molecular N$_2$ leaving oxygen atom behind. In the present study, we investigated the reaction of N$_2$O on rutile TiO$_2$(110) using temperature-programmed desorption (TPD). Our results indicate that N$_2$O does not react over the oxygen vacancy under a typical UHV experimental condition. On a rutile TiO$_2$(110)-1$\times$1 with a well-defined oxygen vacancy concentration of 5% (2.6×10$^{13}$/cm$^2$), N$_2$O desorption features show a monolayer peak maximum at 135 K followed by a small peak maximum at 170 K. When the oxygen vacancy is blocked with H$_2$O, the N$_2$O peak at 170 K disappears completely, indicating that the peak is due to molecular N$_2$O interacting with oxygen vacancy. The integrated amount of desorbed N$_2$O plotted against the amount of adsorbed N$_2$O however shows a straight line with no offset indicating no loss of N$_2$O during our cycles of TPD measurements. In addition, our N$_2$O uptake measurements at 70$\sim$100 K showed no N$_2$ (as a reaction product) desorption except contaminant N$_2$. Also, H$_2$O TPD taken after N$_2$O scattering up to 350 K indicates no change in the vacancy-related H$_2$O desorption peak at 500 K showing no change in the oxygen vacancy concentration after the interaction with N$_2$O.

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