

## Abstract

This work is focused on the laboratory studies of reactions of  $O^+$  and  $N^+$  ions with molecular hydrogen and its isotopologues, HD (hydrogen deuteride) and  $D_2$ . The experimental studies were performed using a 22-pole radiofrequency ion trap in the temperature range from 15 K to 300 K. The temperature dependencies of measured reaction rate coefficients are presented for all reactions. Studied reactions are important for astrochemistry. The reaction of  $O^+$  with  $H_2$  initiates a water production sequence in the interstellar medium, and the rate coefficient does not change dramatically with temperatures in the covered range. The measured rate coefficients for reactions of  $O^+$  with  $H_2$ , HD, and  $D_2$  are close to the corresponding Langevin rate coefficients. The reaction of  $O^+$  with HD has two reaction channels with products,  $OH^+$  and  $OD^+$ . The ratio of rate coefficient of the  $OH^+$  production channel to the total reaction rate coefficient is close to 0.5 in the studied temperature range. The reaction of  $N^+$  with  $H_2$  initiates the ammonia production sequence in the interstellar medium. This reaction has activation energy on the order of a few meV, which is significant in the conditions of the interstellar medium. For reactions of  $N^+$  with  $H_2$  and its isotopologues, activation energies were determined from measured temperature dependencies.