

The aim of this work is the experimental study of recombination of molecular ions with electrons at low temperatures ( $< 300$  K). The work gives an overview of the diagnostic methods, modelling of chemical kinetics, and experimental apparatuses Cryo-FALP II and SA-CRDS used in the undertaken measurements. Two processes were studied in the course of this work: state-selective binary dissociative recombination of  $\text{H}_3^+$  ions in para- $\text{H}_3^+$  and ortho- $\text{H}_3^+$  states, and  $\text{H}_2$ -assisted ternary recombination of  $\text{H}_3^+$ . The main result of the state-selective dissociative recombination study is that the rate of recombination in the para- $\text{H}_3^+$  state is at least three times higher than in the ortho- $\text{H}_3^+$  state at 60 K. The study of  $\text{H}_2$ -assisted recombination gave a better understanding of ternary processes of  $\text{H}_3^+$  ions and removed further discrepancies between results of afterglow experiments.