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Mass spectra and ion energy distribution in a conventional reactive vacuum arc deposition apparatus with Ti cathode and N₂ gas flow were measured. The experiment was carried out at different distances from the cathode surface as a function of gas pressure with an energy quadrupole probe analyzer. From the result of mass spectroscopy, it was found that Ti and N₂ existed in the plasma as neutral particles, and that N might exist as well.

From the data of ion energy measurement, very few N₂⁺ and TiN⁺ were also identified as well as Ti⁺, Ti²⁺, N⁺, and N₂⁺. It was found that their energies and relative quantities depended on the distance from the cathode surface and the gas pressure. Ti⁺⁺ had the highest energy as high as 130 eV and the widest distribution among the ions concerned, and its energy distribution had two peaks at lower pressure and at the position near the cathode. The energy of Ti⁺⁺ decreased with the distance from the cathode surface and increasing the gas pressure. The amount of Ti⁺ increased with distance and the energy was relatively low. The profile of the energy distributions of N⁺ and TiN⁺ showed a similarity to that of Ti⁺⁺. The peak energy of N₂⁺ also had lower energy of about 10 eV, compared with Ti⁺⁺, N⁺ and TiN⁺.

Taking into account the potential hump theory of the cathodic arc, we proposed a novel reaction process in the plasma based on the results obtained here.

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