Micro machines are expected in advanced medical instruments for micro surgery. Typical materials for the actuators in micro machines are shape memory alloys like nickel titanium (TiNi) and piezoelectric compounds like lead zirconate titanate (PZT). For medical application in a future the materials will be required to be deposited directly on surfaces of plastics as thin film in a crystalline structure, since most medical instruments such as catheters for blood vessel surgery are made of polymeric plastics. Then, the film will be finished into some actuators. However, this process had some technical difficulties to be resolved. Since compound film as deposited by physical deposition like magnetron sputtering was usually amorphous, the film had been crystallized traditionally by thermal annealing over 800 K in order to have ferroic properties such as shape memory effect or piezoelectric effect. But the thermal annealing is actually hard to be applied to the above-mentioned medical instruments in a future, since most plastics cannot withstand the higher temperatures than 500 K.

In this study a new apparatus is developed which deposits metallic compound film in crystalline structure directly on a substrate at lower temperature than 500 K. The apparatus consists of a magnetron-sputtering deposition system with multi targets as well as of an ion irradiation system immersed in plasma. The ion irradiation system is basically similar to the plasma based ion implantation system in constitution, although the pulse bias voltage is much lower. Ion acceleration voltage, which corresponds to the bias voltage, is only 50 to 100 V. Another feature of this apparatus is that the elemental proportion in the deposited compound is precisely controlled by adjusting each sputtering condition for the target of respective element. Crystallized films of NiTi were realized with this apparatus at 473 K of substrate temperature. X-ray diffraction profiles of some samples deposited under various conditions show that the ion irradiation in plasma is effective in crystallizing compound film at low temperature. This implies that the crystal film can be directly deposited even on polymers, i.e., materials of low heat resistance.