

## Supplemental Document

Fig. S1. Resistivity, Growth rate, and Density according to deposition temperature

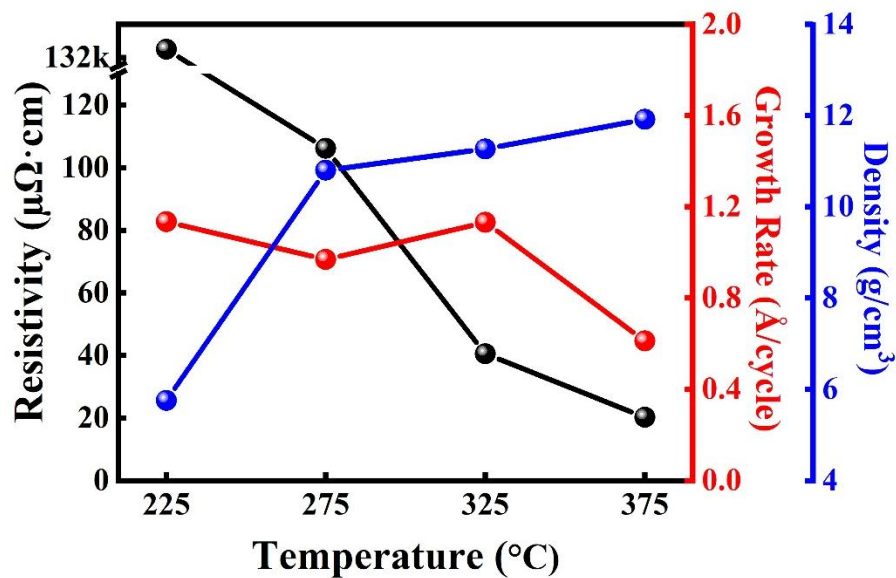
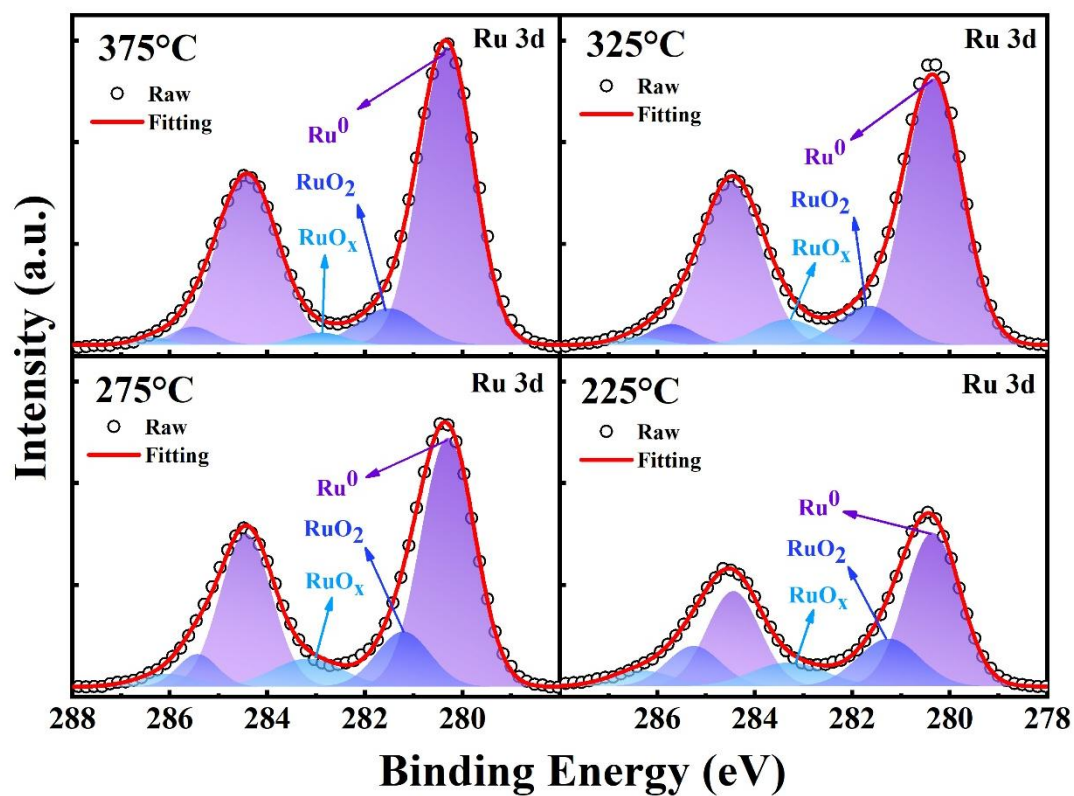


Fig. S2. XPS Analysis of Ruthenium thin films with different deposition temperature



**Fig. S3.** XRD pattern of Ruthenium thin films with different deposition temperature

