Muon spin rotation/relaxation/resonance (μSR) is a technique for measuring the internal magnetic fields of materials by observing decay positrons emitted from polarized muons implanted in a target. In conventional μSR measurements, only the time spectra of decay positrons are analyzed. We are currently developing a system to determine the muon decay position by tracking decay-positron trajectories using silicon strip and pixel detectors, thereby adding two-dimensional spatial information to μSR measurements. Furthermore, by varying the incident muon beam energy, the muon stopping depth can be controlled, enabling depth-resolved measurements. Combining this capability with position-sensitive detection will realize 3D+1 μSR imaging, allowing investigation of material properties on a sub-millimeter scale. This technique is expected to contribute to the development of functional devices such as fuel cells.