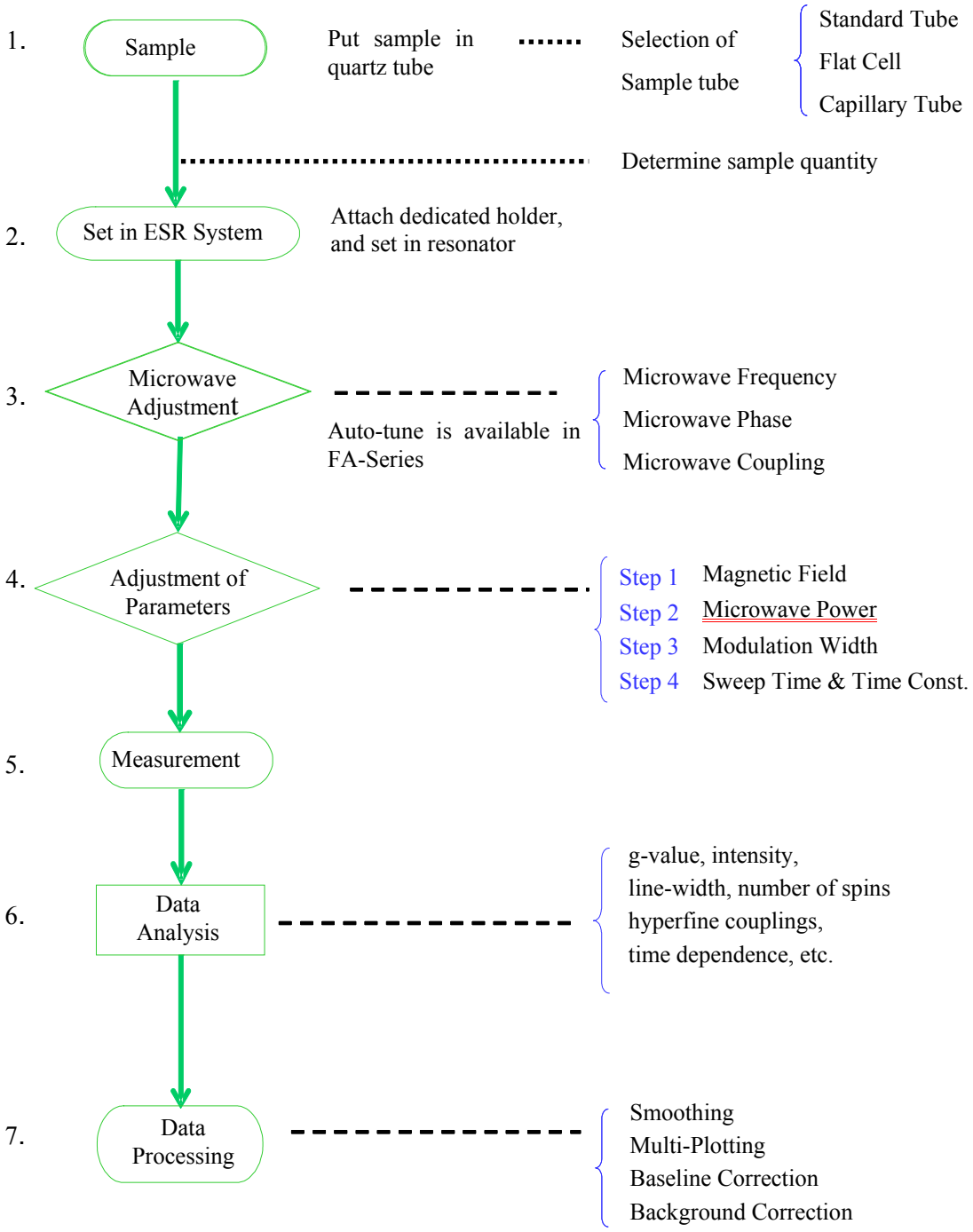
Let's Use ESR V – Adjustment of Microwave Power

ESR may be used to measure a wide range of samples. However, it is necessary to determine the most appropriate conditions for each sample. The following measurement flow chart gives a step-by-step approach. Here, we explain how to determine the microwave power.

ESR Measurement Flow



Step 2. How to Determine Microwave Power

Focus on the signal with which you will optimize the microwave power. If the signal intensity is not enough to judge, enhance S/N using "partial sweep".

Appropriate microwave power is determined by the following procedure.

1. Record the signal using the condition obtained in Step 1 and check the signal intensity (Fig. 1: the height from the peak top to bottom).
2. Increase the microwave power by 4x and check the signal intensity again.
3. Repeat 2 and note the signal intensity at each step. Repeat several times.
4. Reduce the microwave power to ¼ that of 1 and check the signal intensity.
5. Repeat 4 and note the signal intensity at each step. Repeat several times.
6. Plot the signal intensity against the square root of microwave power as shown in Fig. 2.

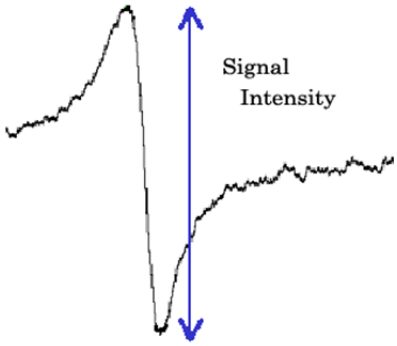


Fig 1. Reading of Signal Intensity

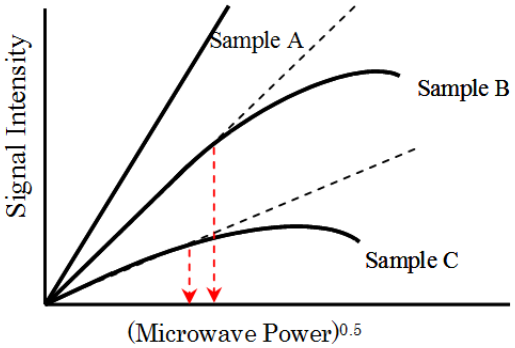


Fig. 2 Microwave Power Affect on Signal Intensity

As shown in Fig. 2, the signal intensity increases in proportion to the square-root of power in ideal conditions. However, the linear response stops at a certain power, and the proportionality fails which is known as "power-saturation". When measuring unknown samples, power-saturation must be avoided.

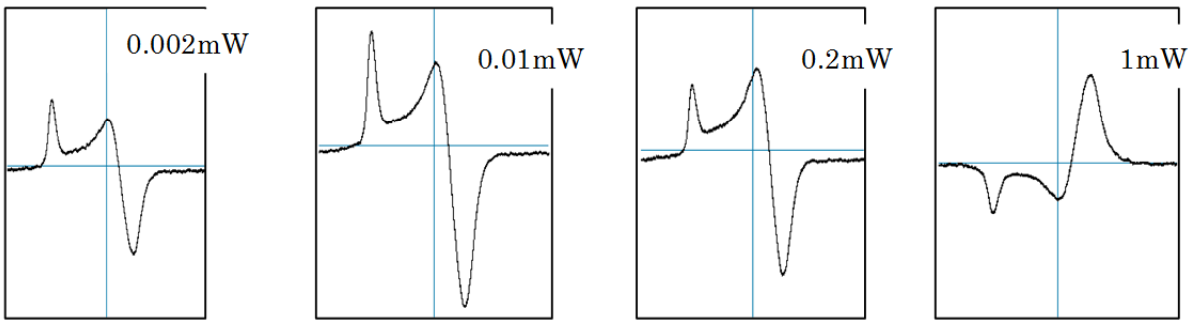


Fig. 3 Power Dependency on ESR line-shape of E' center in Quartz

Fig. 3 shows the ESR signal of E' center in quartz. From 0.002 to 0.01 mW, linearity is good so the proper waveform can be obtained. However at 0.2mW, the signal intensity is attenuated. At 1mW, the spin system is severely saturated and the waveform is badly distorted as a result. Note that line broadening and / or waveform distortion may occur if using inappropriate microwave power.