In-situ crack monitoring during selective laser melting process by wireless and continuous AE waveform measurement

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A battery-powered sensor node capable of continuously measuring and wirelessly transmitting acoustic emission (AE) waveforms was developed and installed in a selective laser melting (SLM) equipment to monitor microcracks during the process. Two heat resistant AE sensors were attached to the substrate, and the process of melting and solidifying of Hastelloy powder layer by laser irradiation was monitored. AE waveform was sampled continuously with about 2 MHz of sampling frequency and 14-bit resolution. The acquired AE continuous waveform was transmitted to a PC outside the SLM equipment for noise reduction and AE event detection. When the laser energy was high, multiple burst AE events were detected during laser irradiation. As a result of event locating, some of the AE events were found to have occurred immediately after laser irradiation. From the timing of occurring, we concluded that they were caused by solidification cracking. Furthermore, other AE events were detected several seconds to several hundred seconds after the irradiation, which could indicate the occurrence of cold cracks. In this way, we proved that our wireless and continuous AE waveform measurement system provides an easy and useful monitoring way to obtain the occurrence timing and position of microcracking during SLM process in a sealed space.