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A MOSSBAUER DIFFRACTOMETER USING A MICROCOMPUTER

I. Sakamoto, N. Hayashi and B. Furubayashi

Division of Quantum Technology, Elektrotechnical Laboratory, Tanashi, Tokyo, Japan

Abstract.—A versatile Mössbauer diffractometer using a microcomputer as devised to separate the elastic scattered intensity and the inelastic one in the vicinity of Bragg reflections. In order to do the separation automatically, a selective modulator is used, which can make a transducer move at a resonant velocity and at a nonresonant one alternately.

It is well known that Mössbauer diffractionometry has a great deal of possibilities in crystalline and magnetic structure investigations /1,2/. However, mainly because of a low counting rate available, Mössbauer diffraction experiments usually need a long measuring time. This is the reason why it is not so popular as X-ray diffraction. Recently a few interesting experiments have been published, where Rayleigh scattering of y-ray was used for the purpose of separating elastic components and inelastic one of the scattered intensity in the vicinity of Bragg reflections.

In this paper, a versatile Mössbauer diffractometer using a microcomputer is described, by which the separation can be made automatically. The diffractometer is composed of a goniometer driven by two stepping motors, two velocity transducers, a selective modulator and a microcomputer. TosiM-12 microcomputer is used as a controller of the goniometer and as a two-input recording unit.

As shown in figure 1, a two-channel stepping motor interface module (PMI), a two-input pulse counter module (PCM) and a digital I/O module (DIO1) are used to control the goniometer. Given a stepping number ranging 1 to 255, a scanning direction and a scanning velocity of 512 Hz or 16 Hz, PMI transfers driving pulses and a signal of forward or reverse rotation to the stepping motor of the goniometer at each channel. When a stepping number counts down and becomes zero at a step counter of PMI, PMI interrupts a CPU. By the command from the CPU, the step counter is reset to zero and driving pulses stop.

PCM counts feedback pulses from a driving circuit of the stepping motor, and according to the command from the CPU, PCM sends a content of the counter to the CPU at each channel.

PCM interrupts the CPU when counts exceed 4095. Only input ports of DIO1 are used to protect the goniometer from an overrun and to set a zero angle at 0 and 20 automatically.

The two-input recording unit for the counting operation at a resonant velocity and at a nonresonant one is composed of two pulse counters having a time base (TBPI1), 2 K (12 bit) Bulk RAM (BRAM) and an analog output module (AOI). At TBPI1, counting operation can be controlled by an inner or outer clock and inhibit pulses. When a setting time counts down and becomes zero, TBPI1 interrupts the CPU. TBPI1 interrupts the CPU when counts exceeds 4095.

During a flyback of the velocity transducer, an inhibit pulse is generated at a driver of the velocity transducer. The inhibit pulse is used to inhibit counting operation of TBPI1. Outputs of TBPI1 are stored in BRAM, and two words in BRAM are used for each angular point.

The counting capacity is $2^{21} - 1$. Angular points...
are selectable ranging 1 to 512 for each of two inputs. Data in BRAM are figured at a oscilloscope through A01.

The selective modulator was constructed to make one of two velocity transducers move and stop alternately in a combination of two modes among constant acceleration mode, constant velocity mode and internal mode (manual selection of a velocity) at two velocity transducers /3/. At internal mode the selective modulator can make a velocity transducer move at a resonant velocity and at a nonresonant one alternately, and can sort counting operations at a resonance and at a nonresonance.

By means of the selective modulator, the separation of the elastic scattered intensity and the inelastic one could be done automatically.

The remainder of the diffractometer comprises an intrinsic germanium detector, amplifier, single channel analyzer, Liq. N$_2$ cryostat, temperature controller and Mössbauer drive system.

In figure 2, the program flow diagram is shown. After keying in a measuring condition at a teletype, measurement is done automatically.

Using the diffractometer, the experiments have been done on SrTiO$_3$ single crystal for investigating its lattice dynamics.

Fig. 2: The program flow diagram.

References

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