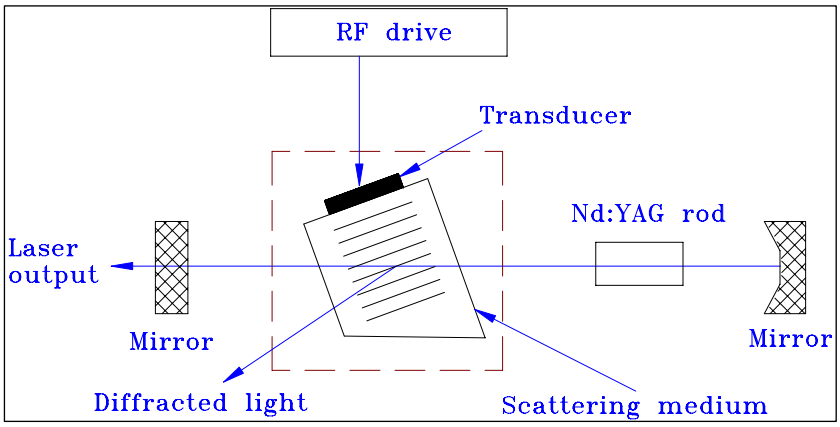
Acousto-Optical Q-switch

The acousto-optical Q-switch often used in the laser marking makes use of mutual interaction between an ultrasonic wave and a light beam in a scattering medium. The light beam that enters in a direction forming a Bragg angle to the wave surface of the acoustic wave in the scattering medium is diffracted in accordance with periodic changes in the diffraction rate produced by the acoustic wave.

The situation is briefly explained. First of all, an RF signal is impressed to the transducer adhered to the molten quartz and thickness extensional vibration is produced. Ultrasonic shear waves are caused to advance in the molten quartz by this vibration, and phase grating formed by acoustic waves is produced. The laser beam is diffracted when it satisfies the Bragg angle with respect to this phase grating, and is separated in space from the incident light.



If the laser optical resonator is constructed against 0-dimensional diffracted light (undiffracted light), the diffracted light deviates from the laser optical resonator axis when a RF signal is impressed. As a result, loss occurs in the laser optical resonator and laser oscillation is suppressed. To make use of this phenomenon, an RF signal is impressed for a certain length of time only (status of low Q-value) to suspend laser oscillation. In the meantime, the population inversion of the Nd:YAG rod is accumulated by continuous pumping. When the RF signal is reduced to zero (status of high Q-value) and the loss to the laser optical resonator is removed, the accumulated energy is activated as laser oscillation in a pulse form within an extremely short length of time. They are Q-switch pulses.

This situation is briefly explained. When an RF signal is subjected to pulse modulation, it is possible to periodically take out a Q-switch pulse. When the period of Q-switch pulses becomes shorter than the life (about 200 μs) of the higher order of the Nd:YAG rod, however, the population inversion decreases and the peak value of Q-switch pulses decreases.