The term "Q-switching" was originated as a shortening of Quality-factor-switching, where the "Q" or quality factor of a laser resonator (or laser cavity) represented the power build up the resonator would support. For a passive, lossless cavity (as would occur between a perfectly reflective mirror and a partially reflective mirror) the Quality factor (Q) would be approximately (1+R)/(1-R), where R is the reflectivity of the partial reflector. That is to say, if a beam of light impinges on the partial reflector of this (Fabry-Perot) cavity after some period of time, the power inside the cavity would be Q times the power outside the cavity. For example, if R were 50% the power inside the Fabry-Perot cavity would build up to be about 3 times the power outside. If R were 95%, Q would be about 19.

Now Q-switching is simply putting something (the Q-switch) inside the cavity that is a time-switchable loss. When the Q-switch is in its high -loss state the cavity Q is low. When the Q-switch is in its low loss state the cavity Q is high. In a laser there must also be a gain medium placed inside the laser cavity. If there were no Q-switch, the laser gain would build up during the time the gain material was optically pumped. In this case, when the gain of the pumped material exceeded the cavity loss, the laser would lase, and light would be emitted from the partial reflector. If the Q-switch is inserted into the cavity, the laser does not lase when the Q-switch is in its high loss state, even when the gain medium is being pumped. This permits the excitation level in the gain medium to build up to a level higher than could be otherwise achieved had lasing been allowed. In such case, when the Q-switch is suddenly switched to the low loss state a lot of energy is extracted from the gain medium (into the light field) in a short amount of time -- so a high energy, short pulse (i.e., high peak power) is generated.

As an aside: It is one of the astonishing things about the way stimulated emission works, that if you put your hand into a high power laser beam outside the laser cavity, you will certainly be hurt. However, if you put your hand into the beam inside the laser cavity, where the light power would be much higher due to the high Q-factor, the lasing action stops and your hand is perfectly safe. Your hand spoils the Q of the laser cavity.

In summary, the use of a Q-switch is very simply stated. It provides a simple means to generate a very short, high peak power laser pulse. It operates like a very fast switch inside the laser cavity. It is the additional peak power that provides a pulse with sufficient energy in a short enough period to kill the fungus (or other infectious agent), either by rapid heating or mechanical shock, or both, without generating sufficient heat to kill surrounding tissues.

I hope this detail is clear enough to follow.

Best regards,

--Don

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