

CLAIMS

1. An inspection apparatus, comprising:

an optical target including a solid host material and a fluorescing material embedded in the solid host material, the solid host material having a predetermined phonon energy $HOST_{PE}$;

a body having a pocket to receive the optical target, wherein the body includes an inset region located at a top surface and surrounding the pocket; and

a transparent layer mounted in the inset region and positioned above the optical target;

wherein the body includes a channel at least partially surrounding the pocket, the channel to receive an adhesive to bond to a grating layer, wherein the channel includes a series of pressure relief pockets distributed about the channel, the pressure relief pockets to relieve stress induced onto the grating layer by the adhesive during a curing process;

wherein the fluorescing material exhibits a select ground energy level and a target excitation (TE) energy level separated from the ground energy level by a first energy gap corresponding to a fluorescence emission wavelength of interest (FEWI), the fluorescing material having a next lower lying (NLL) energy level relative to the TE energy level, the NLL energy level spaced a second energy gap FM_{EG2} below the TE energy level wherein a ratio of the $FM_{EG2}/HOST_{PE}$ is three or more.

2. The apparatus of claim 1, wherein the ratio of the $FM_{EG2}/HOST_{PE}$ equals or is between four and ten.

3. The apparatus of claim 1, wherein the solid host material includes at least one of glass, amorphous polymers, crystalline materials, semi-crystalline polymers, metallic glass, or ceramic.

4. The apparatus of claim 1, wherein the fluorescing material represents an ion of at least one of a rare-earth element or a transition metal element.

5. The apparatus of claim 1, wherein the solid host material has a maximum phonon energy less than or equal to 580 cm^{-1} .

6. The apparatus of claim 1, wherein the fluorescence emission wavelength of interest has a center wavelength at or below about 1000 nm.

7. The apparatus of claim 1, wherein the body further includes a diffusion well located below the pocket, the diffusion well to receive excitation light passing through the optical target, the diffusion well including a well bottom having a surface finish that exhibits a reflectivity of no more than about 20.0%.

8. The apparatus of claim 1, further comprising microstructures formed on a surface of at least one of the transparent layer or the optical target to form a grating layer.
9. The apparatus of claim 1, further comprising an anti-reflective coating formed on a surface of at least one of the transparent layer or the optical target.