

optimising x-ray imaging performance using columnar CsI:Tl vs phosphor depositions

The growing demand for digital X-ray imaging across a range of markets – particularly medical & dental applications – has created demand for enhanced imaging properties of scintillators. CsI:Tl offers particularly important benefits when customised to provide optimised application solution.

Background

Digital imaging is rapidly advancing - particularly in dental diagnosis – with one of the major imaging techniques being based on scintillator coated fibre optic face plates (FOFPs) bonded to CCD or CMOS devices.

Key to successful diagnosis is conflicting technical requirements which demand scintillator optimisation.

These include:

- ◆ high resolution imaging for diagnosis with high efficiency to minimise dose
- ◆ high X-ray absorption for improved signal:noise but preferential absorption of low energy X-rays for soft tissue diagnosis
- ◆ low granularity and high homogeneity of imaging field
- ◆ slim, convenient packaging which is robust, safe and has long life

The Applied Scintillation Technologies Solution

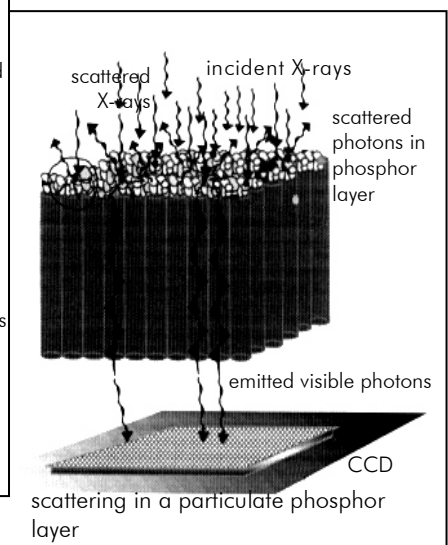
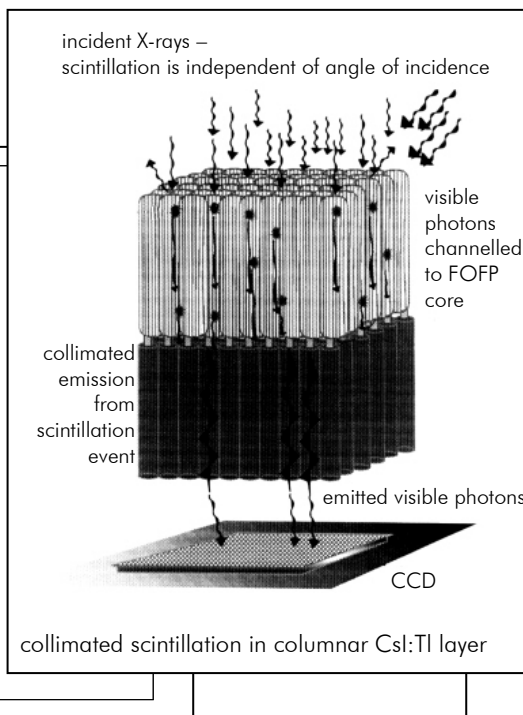
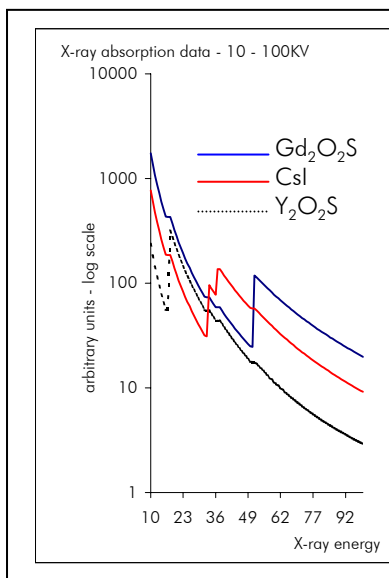
Applied Scintillation Technologies (AST) has extensive experience in the custom development and production of optimised scintillator layers.

Normally using Schott Fiber Optics FOFPs which have high X-ray absorption, (thus protecting the CCD for extended life) AST provides X-ray screen for bonding and directly deposits phosphors and CsI:Tl for use in dental and other similar applications.

Columnar CsI:Tl grown preferentially on the FOP core using AST's FOP etch techniques has proved particularly successful – detecting dental caries significantly earlier than other techniques.

The columnar nature reduces scatter, the absorption edge is in the middle of the X-ray spectrum range, the thickness is readily customised and the intrinsic efficiency is high.

These features, combined with AST's optimisation of reflector and absorber layers, provide maximum imaging benefits to dentists and patients.



AST Products

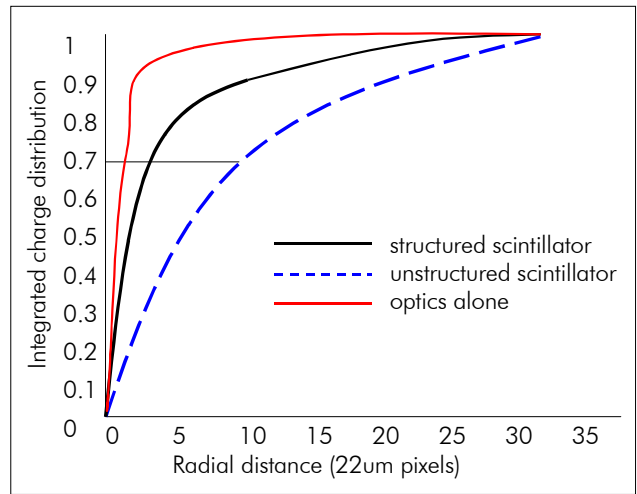
Comparing competitive bonded X-ray screen, AST's $Gd_2O_2S:Tb$ (Gadox) phosphor deposition and columnar $CsI:Tl$ products highlights the benefits conferred by columnar growth registered to the FOFP core.

The resolution performance demonstrated throughout the MTF curve shows $CsI:Tl$ to have significant advantages with ultimate resolution being >18line pairs/mm as opposed to the 12-14lp/mm provided by the Gadox layer.

Further, while Gadox has good efficiency, this is derived preferentially from the higher energy X-rays – $CsI:Tl$'s efficiency is derived at lower energies thus providing enhanced soft tissue imaging.

Other phosphors such as $Y_2O_2S:Tb$ do absorb at low energies but are insufficiently dense to provide the high quality particulate layers and hence imaging performance seen from AST's columnar $CsI:Tl$ depositions.

Graph demonstrating improved performance of structured scintillator (CsI) over unstructured scintillator (Gadox)



Sample Comparative Specifications of Typical Scintillator Configurations for Dental Imaging

Substrate - Schott Fiber Optics FOFPs – 6um core – 75:25 core clad ratio
X-ray source - conventional 60KVp dental source

Example scintillator	$CsI:Tl$ 55um thick – Al reflector	$Gd_2O_2S:Tb$ 35mg/cm ² – diffuse reflector LANEX screen	$Gd_2O_2S:Tb$ 25mg/cm ² – Al reflector	$Y_2O_2S:Tb$ 30mg/cm ² – Al reflector
relative efficiency	0.68	1.0	0.96	0.81
MTF @ 8lp/mm (%)	65.8	46.3	54.5	27.8
MTF @ 12lp/mm (%)	42.0	22.8	28.1	13.2
absorption edge	med – 33KV	high – 50KV	high – 50KV	Low – 17KV
flat-field std. dev. (%)	4.3	1.4	1.5	1.9
material density (g/cm ³)	4.5	7.6	7.6	4.1
layer density (g/cm ³)	approx 3.2	approx 4.5	approx 4.5	approx 2.2
structure/particle size	columnar poly-crystal	screen bond particle, 5um med	direct deposit particle, 4um med	direct deposit particle, 7um med

Applied Scintillation Technologies has the knowledge and expertise based on years of experience to partner you in the development of custom $CsI:Tl$ products for dental, mammography & other X-ray imaging applications.

Resolution, sensitivity, speed & colour of response are a few of the parameters that can be influenced in the production of a customised product that more closely relates to your customer need.

- ◆ A customised product is often a more cost effective solution
- ◆ Formulations can be developed to meet your specific requirements
- ◆ Exceed your initial expectations through partnership development
- ◆ An ISO9002 company – quality assurance is guaranteed through every delivery
- ◆ Product differentiation can provide unique product positioning versus competitors
- ◆ Enjoy continued product development and technical support through partnership

APPLIED SCINTILLATION TECHNOLOGIES LTD
8 ROYDONBURY INDUSTRIAL ESTATE
HORSECROFT ROAD
HARLOW CM19 5BZ UNITED KINGDOM
TEL +44 [0] 1279 641234 FAX +44 [0] 1279 413679
e-mail sales@appscintech.com



APPLIED SCINTILLATION TECHNOLOGIES

www.appscintech.com