CHALMERS

COMRAD

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Workpackages

Workpackage 1:

Because of the different spectral response of silver film and digital detectors/imaging plates, digital techniques exhibit an increased sensitivity to ***scattered radiation****.*

Workpackage 2:

CR/DR has an ***inherent unsharpness*** *determined by the phosphor (CR) or scintillator (DR) structure and the reading process, limiting the spatial resolution. Address a reliable assessment of the* ***effective spatial resolution****, its* ***modelling*** *using* ***modulation transfer functions****, and a practical verification using suitable IQIs.*

Workpackages

Workpackage 3:

*While the **signal to noise ratio** is a performance limiting factor, digital detector arrays potentially can obtain significantly higher signal to noise ratios by the integration of multiple frames by the acquisition computer.*

*A precondition for the successful application of this technique is an appropriate **detector calibration**, which also permits the reduction of fixed pattern noise.*

Workpackage 4:

*The selection of **suitable source energy** is even more important for digital radiography than for traditional film radiography.*

Workpackages

Workpackage 5:

*At the end of the inspection, CR or DR techniques provide an image. The final image is **interpreted** on a **computer screen** with some specifics software currently allowing zoom and image processing.*

*Recommendations must be given to **define the interpretation conditions** for example: type of computer screen (8 bits, 10 bits or 12 bits, colour or monochrome) , image processing …*

Simulation softwares

- aRTist
  -ray tracing

- PENELOPE
  -Monte Carlo

Defects

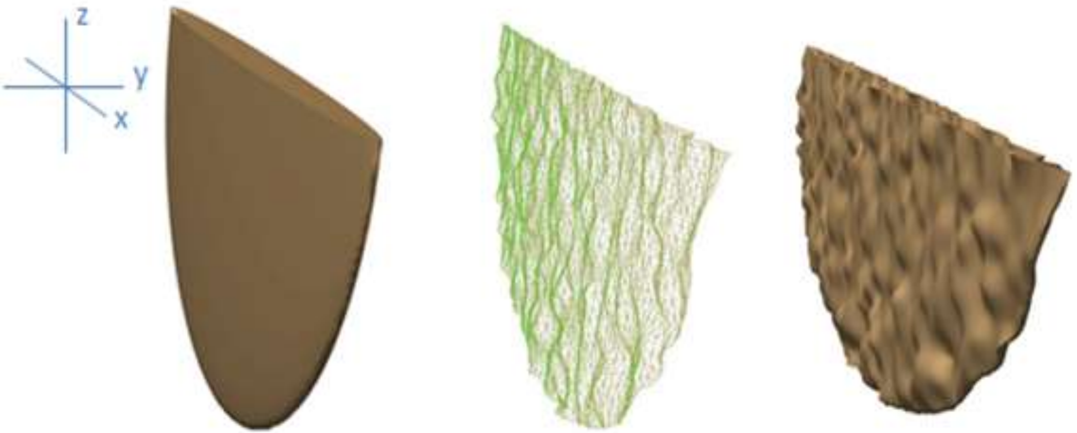
Material group	Mechanical fatigue	Thermal fatigue	IGSCC	TGSCC	IDSCC
Austenitic stainless steels	3/(2)	16/(22)	38/(39)	5/(19)	0/(0)
Depth [mm]	1-3; 6; 12	1-10; 14; 19	0,3-10; 13; 17	1-4; 6; 8; 10	
Width (mean)	130	39,7	37,7	31,1	
Width (median)	28	28,5	30	20	
Width (std)	182	29,0	28,7	34,5	
R_z (mean)	43,6	54,8	70,7	37,1	
R_z (median)	13	45	68	36	
R_z (std)	74,8	34,0	39,6	21,6	
λ_0 (mean)	312	136	78,4	38,9	
λ_0 (median)	250	106	71	21	
Nickel base alloys	0/(0)	0/(0)	3/(16)	0/(3)	17/(13)
Depth [mm]			0-2; 3,5; 4,2		0-1,5; 3
Width (mean)			42,4		31
Width (median)			17,5		20
Width (std)			67,7		34,6
RZ (mean)			42,8		111
RZ (median)			27		80
RZ (std)			36,0		84,3
λ0 (mean)			34,9		150
λ0 (median)			14		113
Others	1/(1)	0/(0)	1/(1)	0/(0)	0/(0)
Total	4/(3)	16/(22)	42/(56)	5/(22)	17/13)

Defect data is based on: Rapport SKI 2006:24

CAD defects

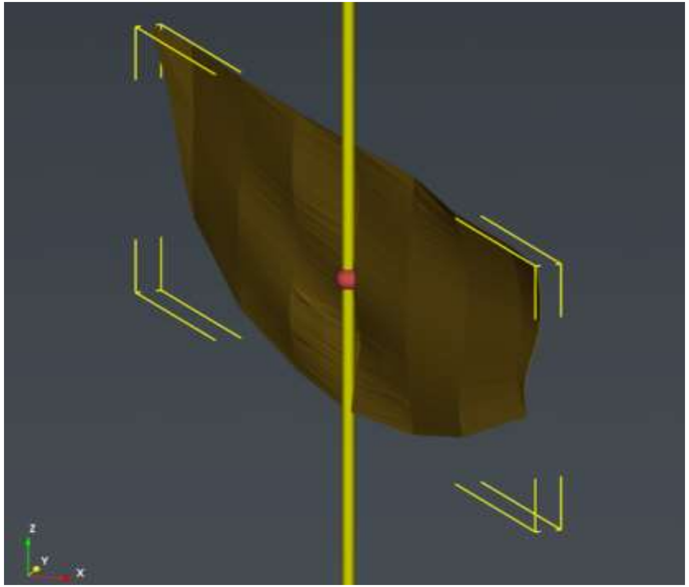
- Ellipsoid based on crack data.
- Statistical variation superimposed on ellipsoid.
- Resulting in a crack with realistic volume and surface roughness.

d = crack depth(z-axis)
l = crack lengt(x-axis)
w = crack width(y-axis)

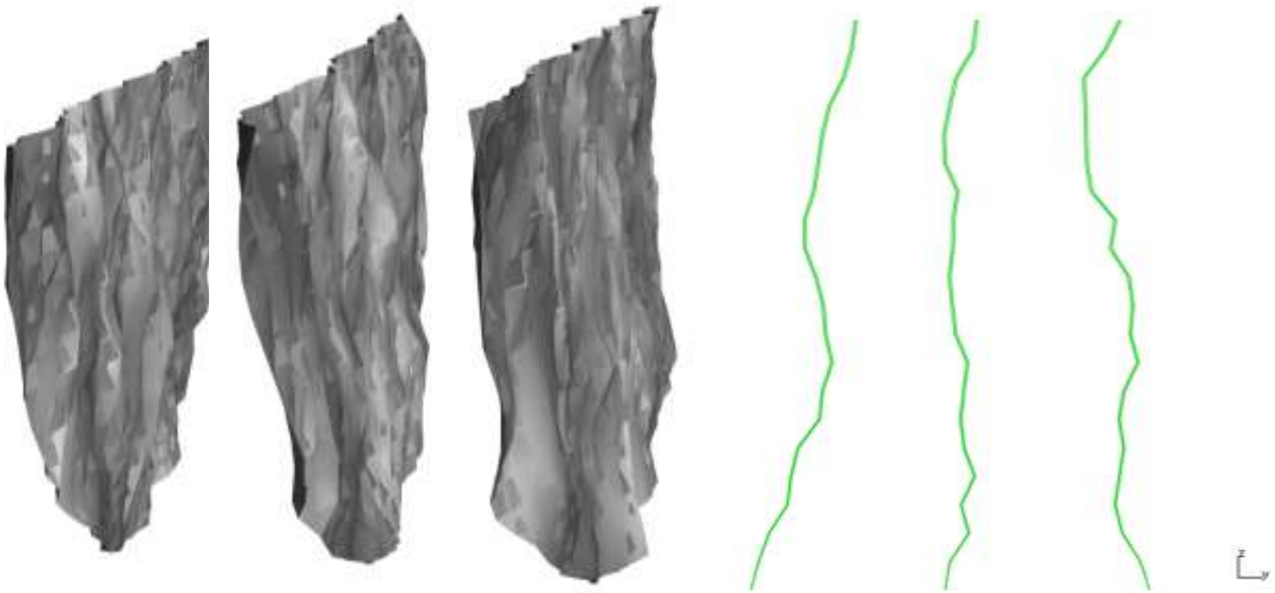


Simulated defects

Crack	x [mm]	y [mm]	z [mm]	w [µm]
3	7,2	0,18	2,0	7,5
4	14,6	0,16	4,0	15
5	23,6	0,17	6,9	30
6	31,6	0,18	10,0	40
7	41,6	0,19	14,0	50
8	59,6	0,20	20,9	60
9	79,6	0,25	27,9	80



Simulated defects

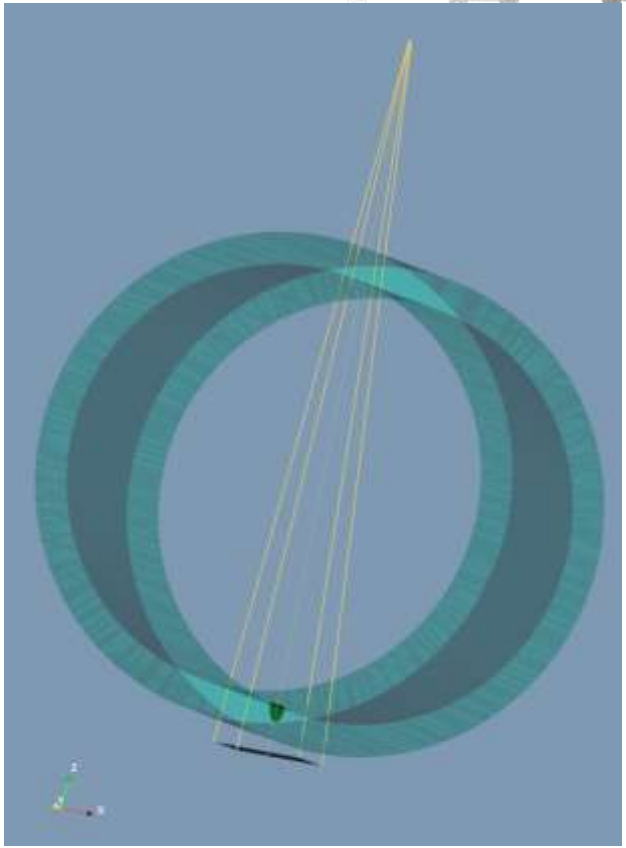


Test objects

Object nr1:
Diameter: 110 [mm]
Thickness: 10 [mm]
Cracks: 3, 4, 5 (20%, 40%, 69%)

Object nr2:
Diameter: 273 [mm]
Thickness: 18 [mm]
Cracks: 4, 5, 6 (22%, 38%, 56%)

Object nr3:
Diameter: 463 [mm]
Thickness: 35 [mm]
Cracks: 6, 7, 8 (20%, 40%, 60%)



Scattering (WP1)

Broad beam

Narrow beam

$$Built - up = 1 + \frac{I_S}{I_D}$$

110/10 mm FFD=240mm

kV	Id	Is	B-up
200	3.45	6.09	2.8
250	6.03	11.26	2.9
300	8.19	15.46	2.9
350	9.98	19.33	2.9

273/18 mm FFD=403mm

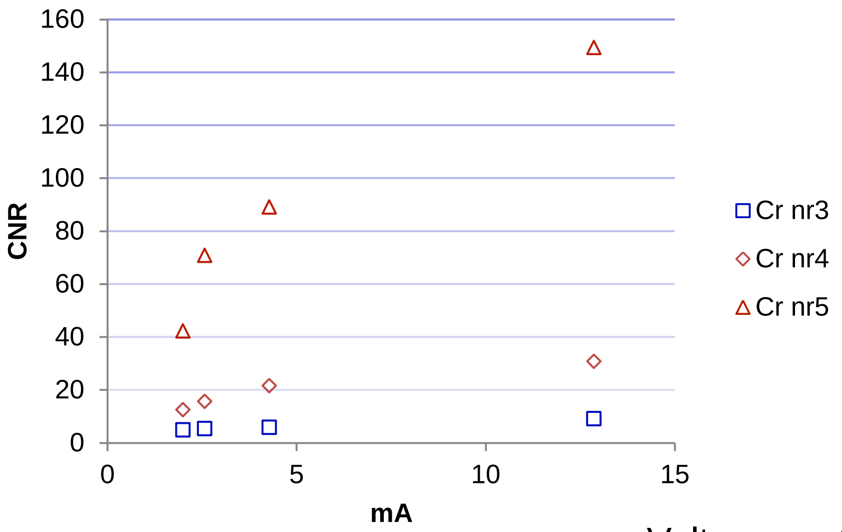
kV	Id	Is	B-up
300	0.95	2.61	3.7
350	1.28	3.66	3.9
400	1.67	4.56	3.7
450	2.03	5.41	3.7

463/35 mm FFD=593mm

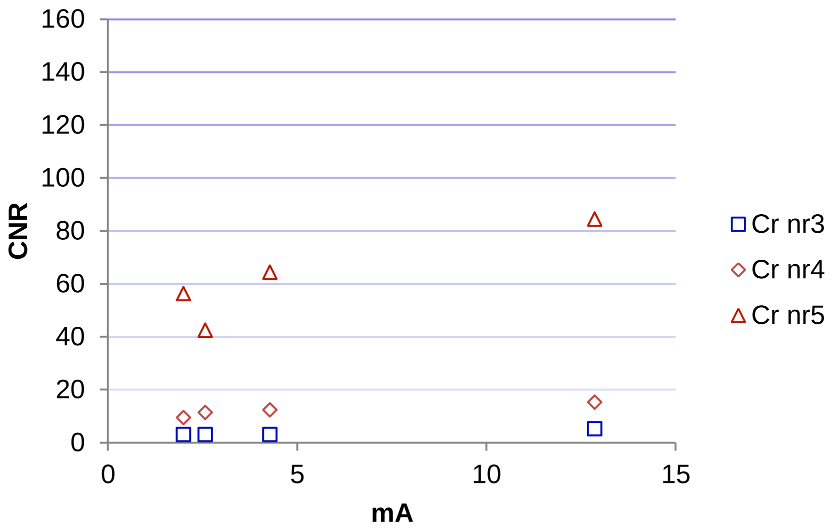
kV	Id	Is	B-up
450	0.03	0.19	6.9
600	0.05	0.32	7.3
800	0.11	0.67	7.0

Unsharpness (WP2)

GE DXR500L

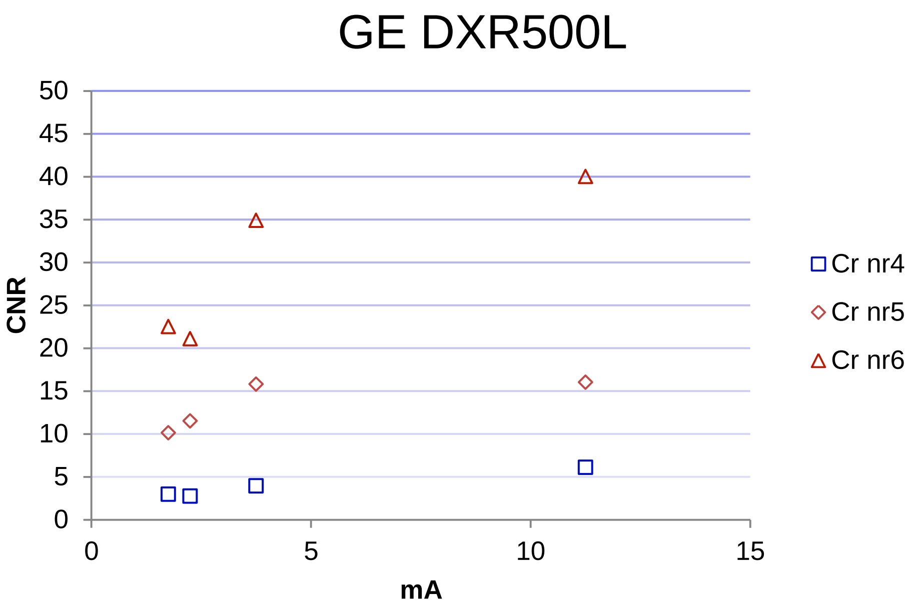


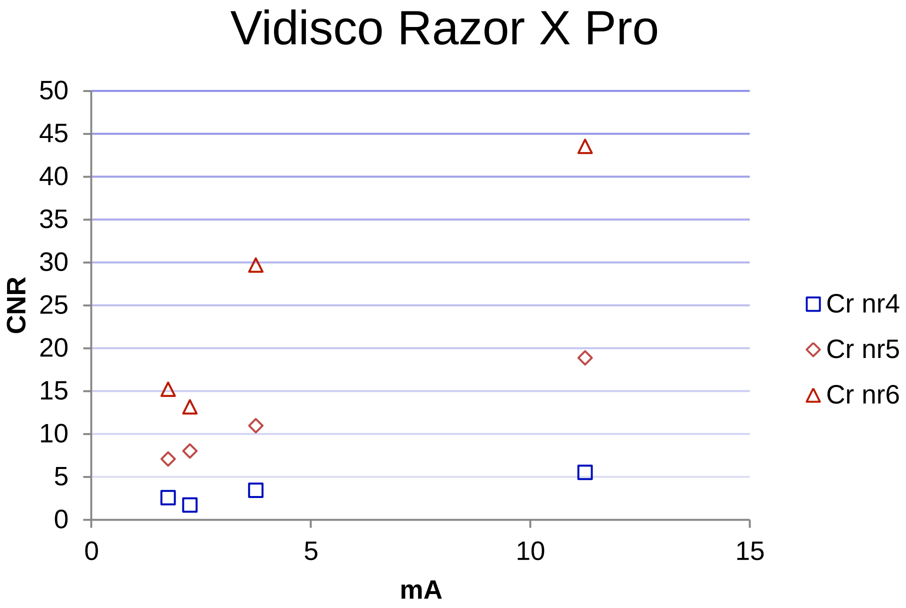
Vidisco Razor X Pro



Voltage:	350 kV
Object:	110/10 mm

Unsharpness (WP2)

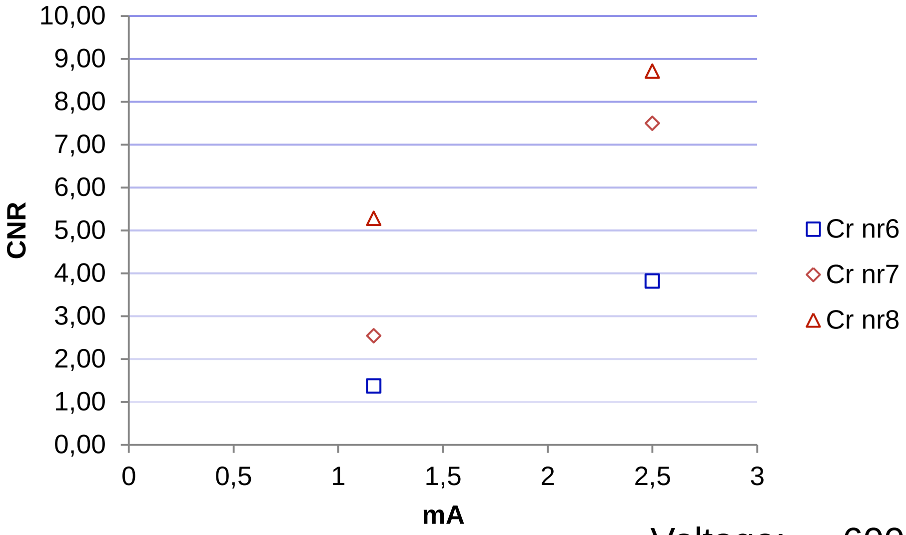




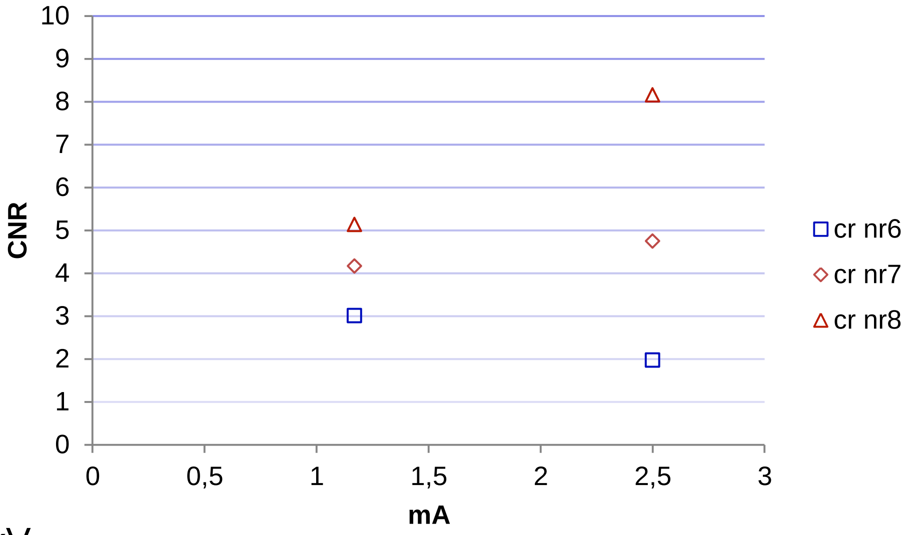
Voltage: 400 kV
Object: 273/18 mm

Unsharpness (WP2)

GE DXR500L



Vidisco Razor X Pro



Voltage: 600 kV
Object: 463/35 mm

Efficiency (WP3)

Eff. = Efficiency [SNR_n/mGy^-0.5]			
Namn:	DXR500 L		
px_size:	0.1	mm	SRb=0.100 mm
fillfactor:	0.5		
110/10 mm	FFD=240mm		
kV	Gain	GV/mGy	Eff_n
200	0.25	38858	321.0
250	0.5	52646	267.0
300	0.5	40133	226.0
350	0.5	32211	213.0
273/18 mm	FFD=403mm		
kV	Gain	GV/mGy	Eff_n
300	1	60781	190.0
350	1	48352	173.0
400	1	40106	157.0
450	1	33974	142.0
463/35 mm	FFD=593mm		
kV	Gain	GV/mGy	Eff_n
450	2	47737	112.0
600	2	32385	91.0
800	2	22019	75.0

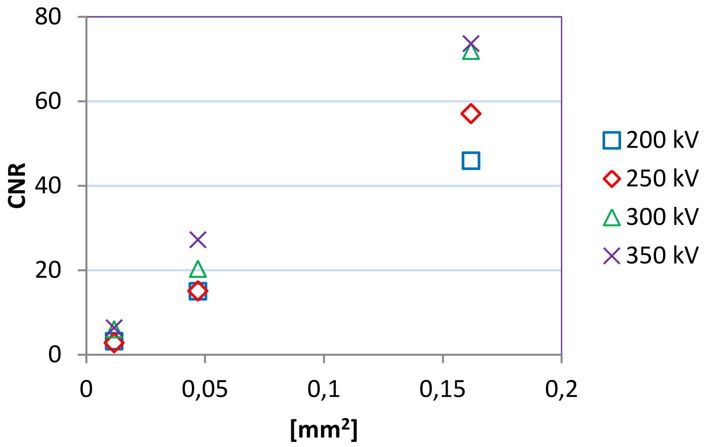
GE DXR500L

Efficiency (WP3)

Eff. = Efficiency [SNR_n/mGy^-0.5]			
Namn:	Vidisco Razor X		
px_size:	0.142	mm	SRb=0.142 mm
fillfactor:	0.65		
110/10 mm	FFD=240mm		
kV	Gain	GV/mGy	Eff_n
200	0.5	54584	297.0
250	0.5	36976	219.0
300	0.5	28188	179.0
350	0.5	22623	157.0
273/18 mm	FFD=403mm		
kV	Gain	GV/mGy	Eff_n
300	1	42690	146.0
350	1	33961	131.0
400	1	28169	119.0
450	1	23862	108.0
463/36 mm	FFD=593mm		
kV	Gain	GV/mGy	Eff_n
450	2	33528	88.0
600	2	22746	71.0
800	2	15465	63.0

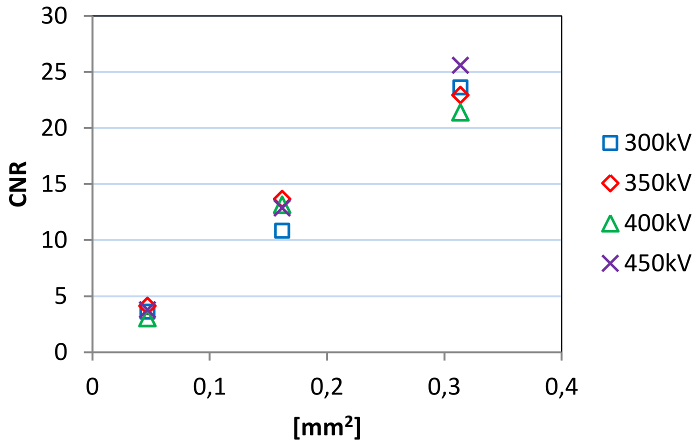
Vidisco Razor X Pro

Source energy (WP4)



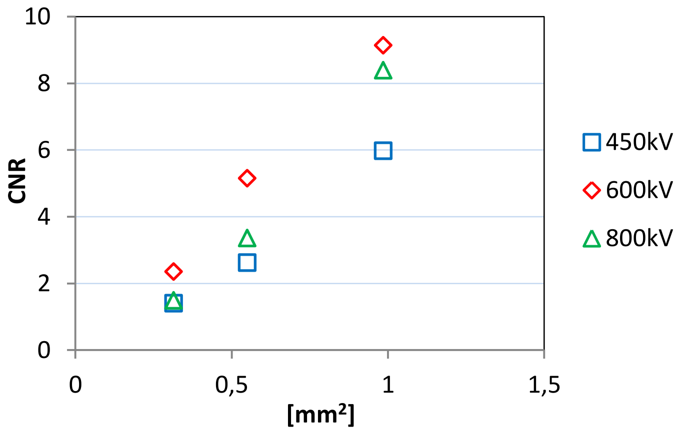
Voltages for test object 110/10 mm

Source energy (WP4)



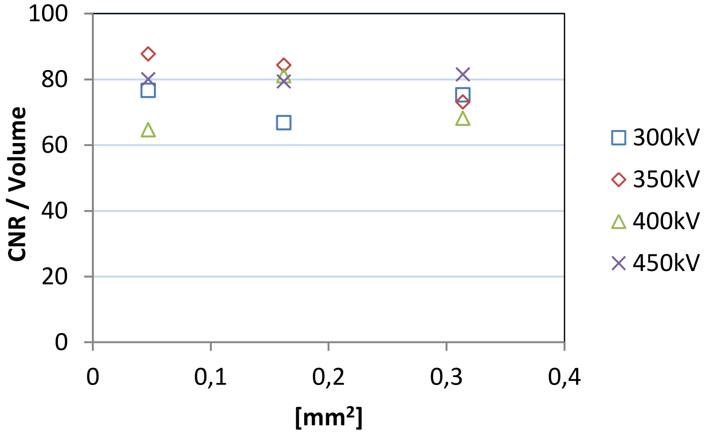
Voltages for test object 271/18 mm

Source energy (WP4)



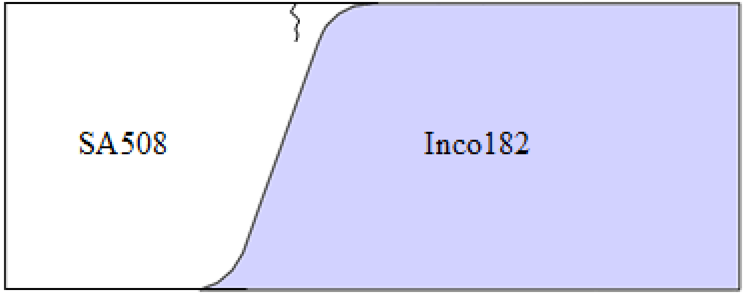
Voltages for test object 463/35 mm

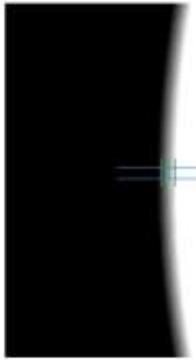
Source energy (WP4)

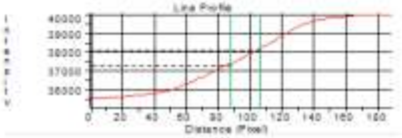


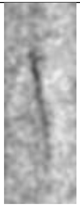
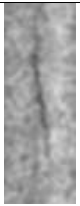
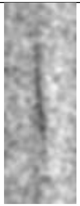
CNR / volume-ratio

Interpretion (WP5)







width [µm]	Bending		
	minus	none	plus
7,5			
5,0			
3,75			

- ✓ In this work, the detector performance is simulated but it should be verified with tests of detectors under realistic conditions.

- ✓ The contrast of a defect in at test block should be verified. In WP4 it is shown that the ratio between the contrast and defect volume is constant.

- ✓ Further studies of known defects should be done. Previous studies [2] could be re-used and supplemented with more material about defect volumes.

AVANCEZ

1829

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