

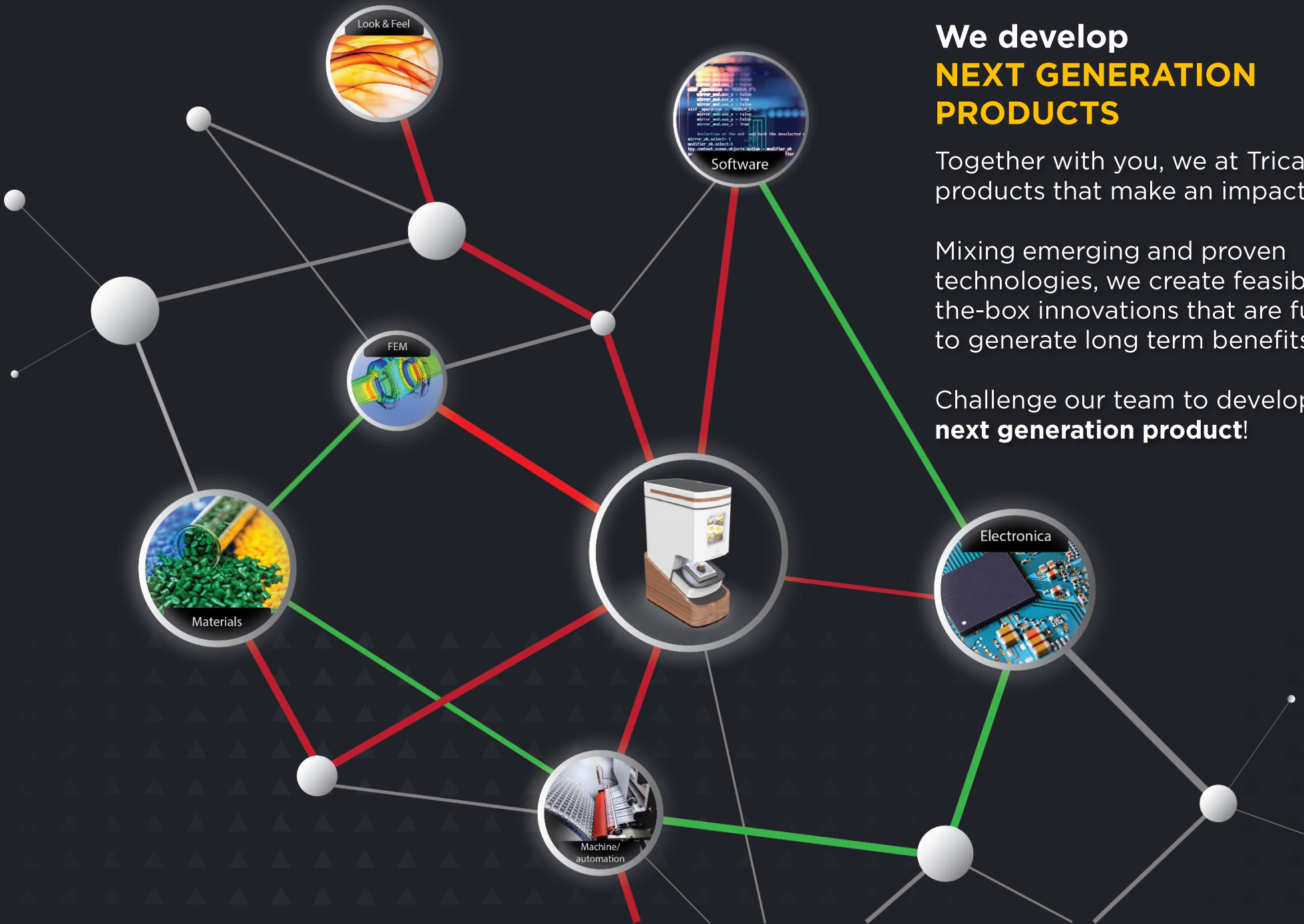
TRICAS

www.tricas.nl



NIR Technology & Plastics

making the invisible visible



We develop NEXT GENERATION PRODUCTS

Together with you, we at Tricas create products that make an impact.

Mixing emerging and proven technologies, we create feasible out-of-the-box innovations that are future proof to generate long term benefits.

Challenge our team to develop your **next generation product!**

Research questions arise from customer requests. In this case our customer designs and builds machines for high speed product assembly.



Customer request:

Investigate the possibilities of visually checking inside an opaque polymer assembly without damaging it.

Inspiration

On the right we see a picture taken by a speed camera. The grass and the leaves appear almost white in this picture. This is different from a traditional black and white image.

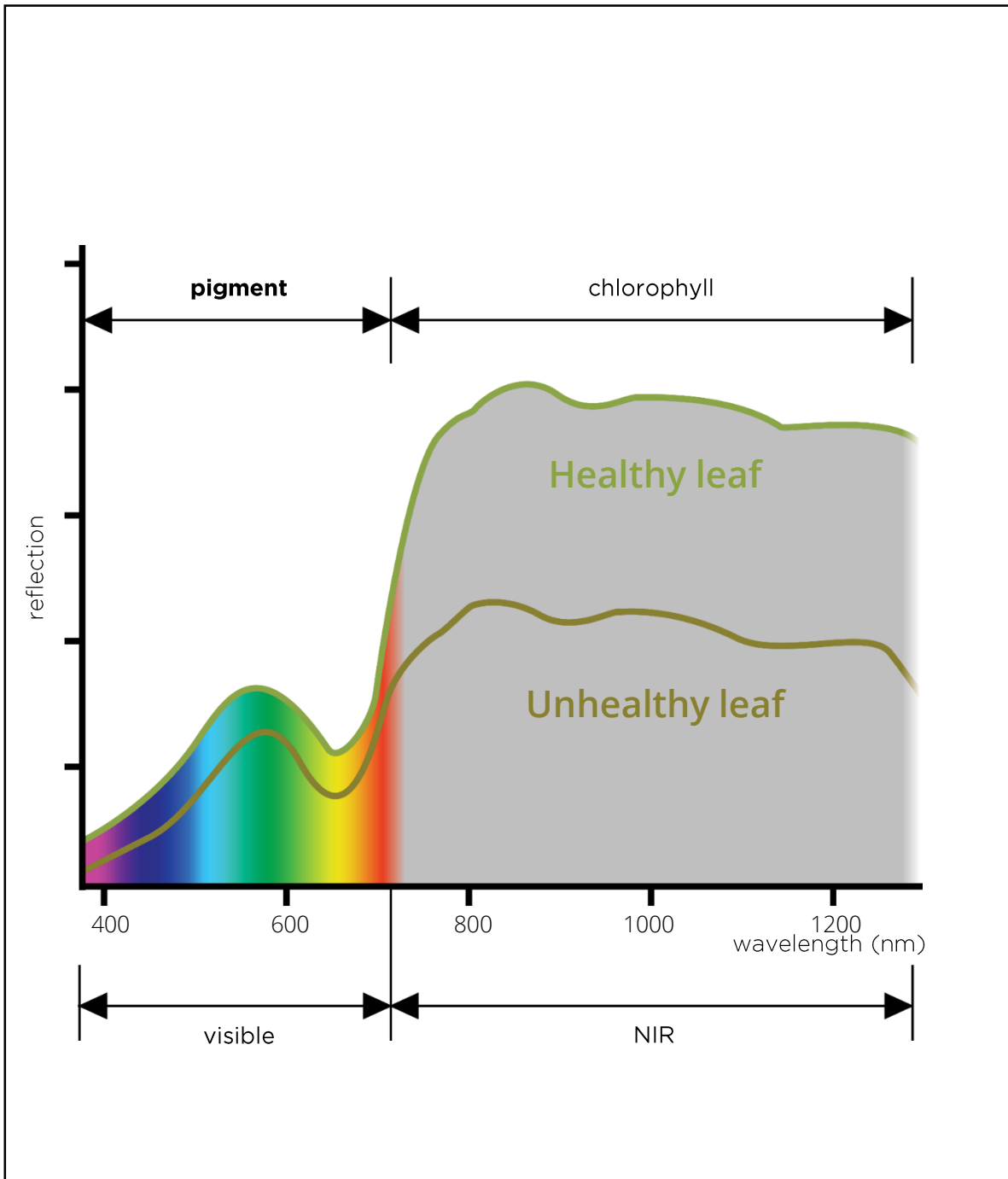
The reason for the grass and leaves to appear this light is because they were photographed in the Near Infrared spectrum (NIR).

Traditional black and white photograph



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Snelheid: 62 km/h

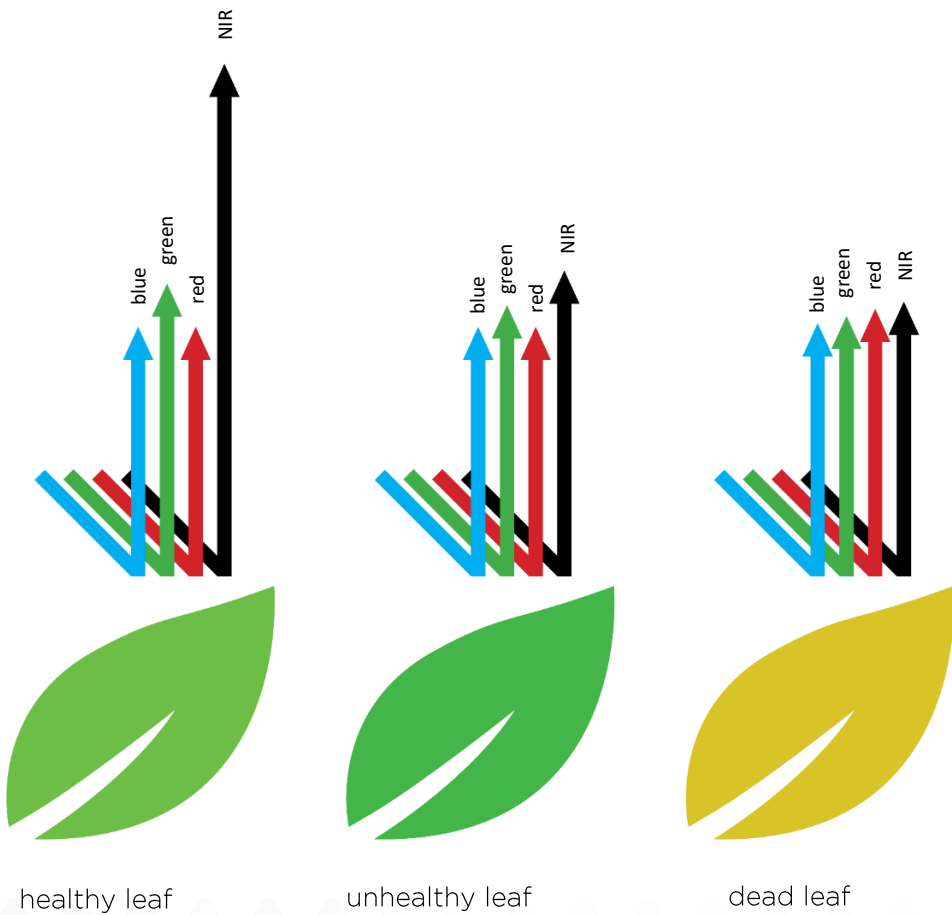
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Rijrichting:
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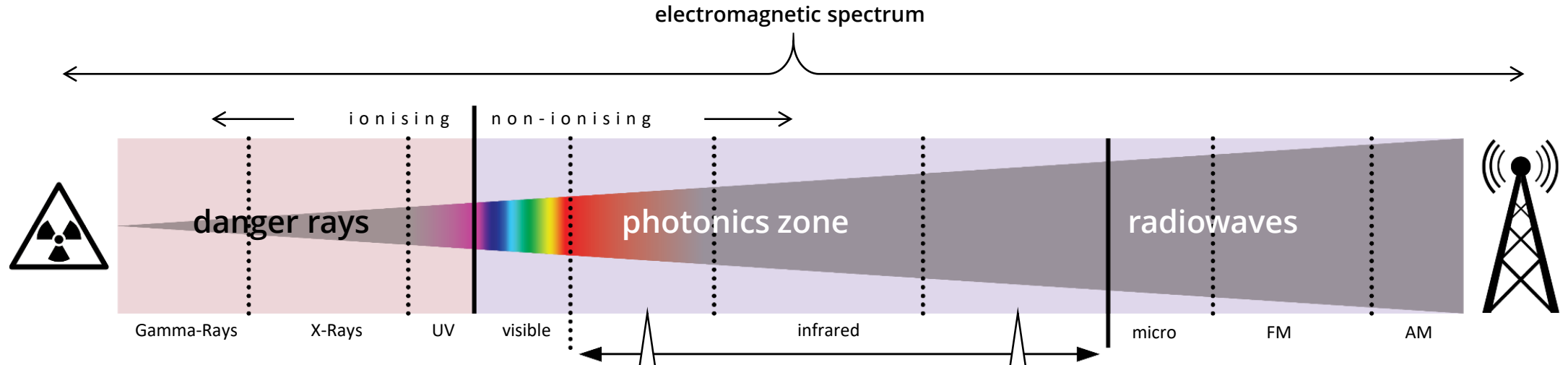
Inspiration

The chlorophyll that is inside healthy leaves, has a high reflectivity of light in the Near Infrared spectrum (NIR)

Unhealthy leaves have a lower chlorophyll content and therefore reflect less NIR.



What is Near Infrared



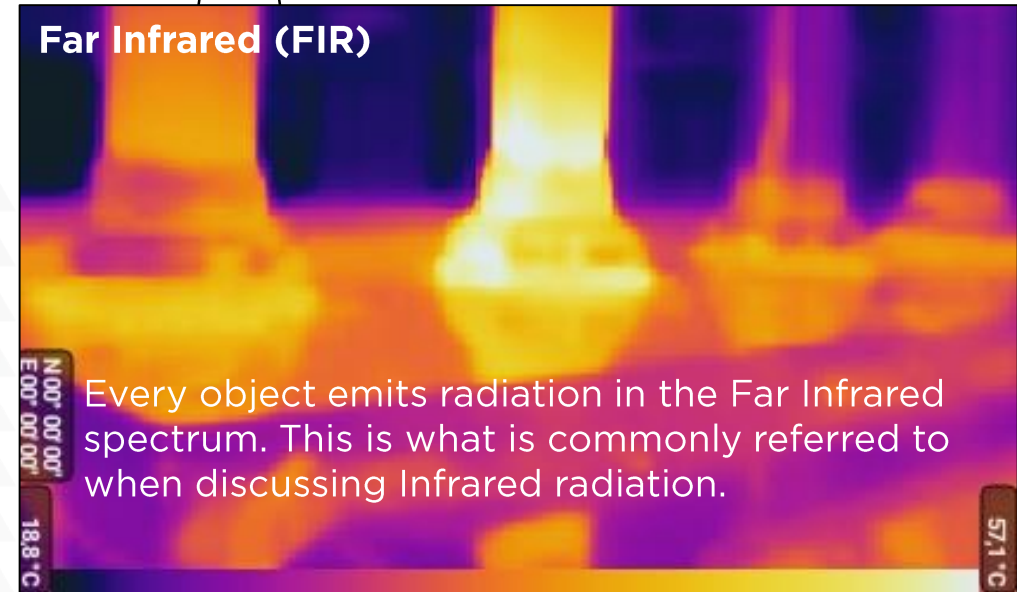
Near Infrared (NIR)

Near Infrared is close to the visible light spectrum and behaves in a similar way.



Far Infrared (FIR)

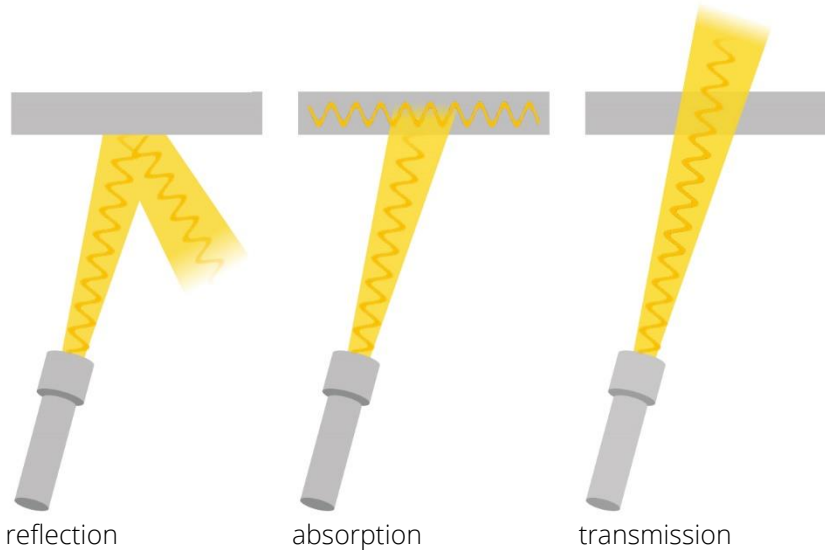
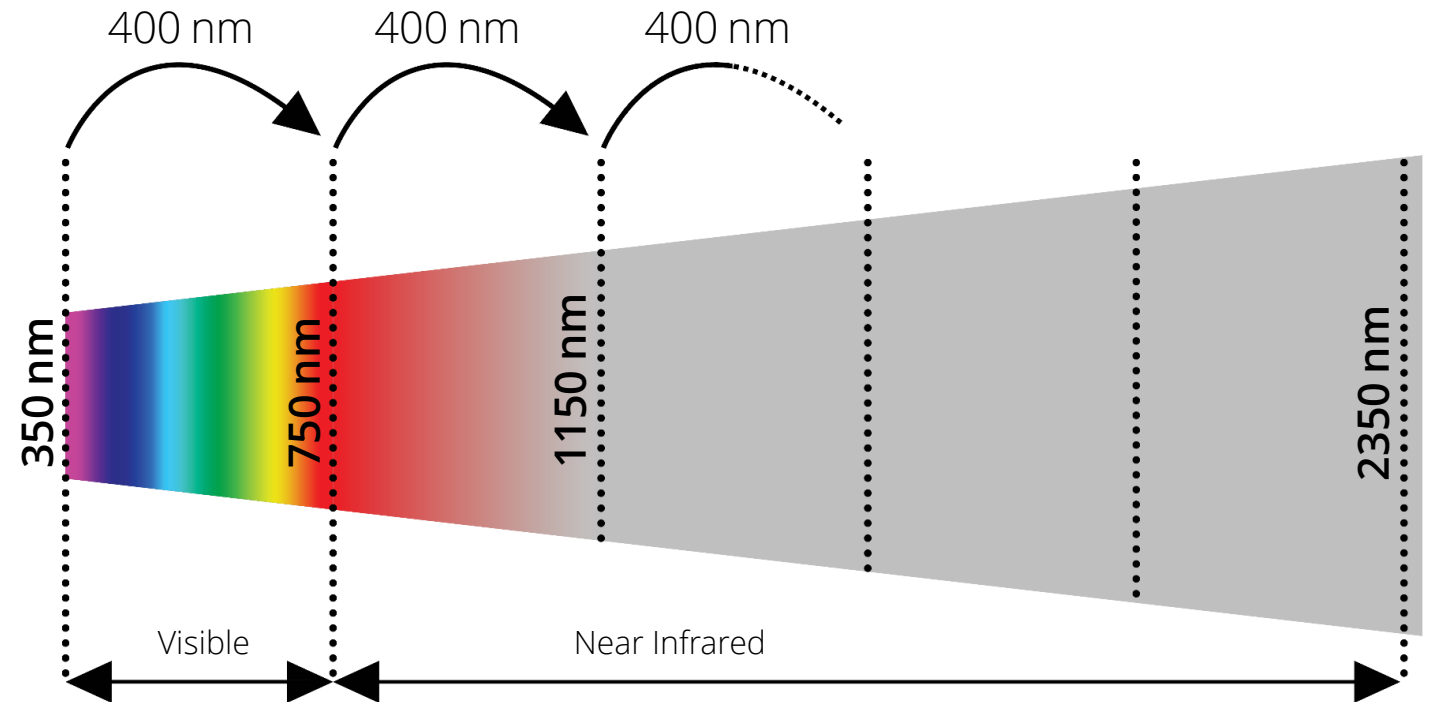
Every object emits radiation in the Far Infrared spectrum. This is what is commonly referred to when discussing Infrared radiation.



What is Near Infrared

The spectrum that can be registered by the human eye is “only” about 400nm wide.

The NIR area is several of these 400nm steps wide and with the help of a computer a large quantity of information can be extracted.



Infrared in the NIR spectrum behaves just like visible light. It can be reflected, absorbed or transmitted.

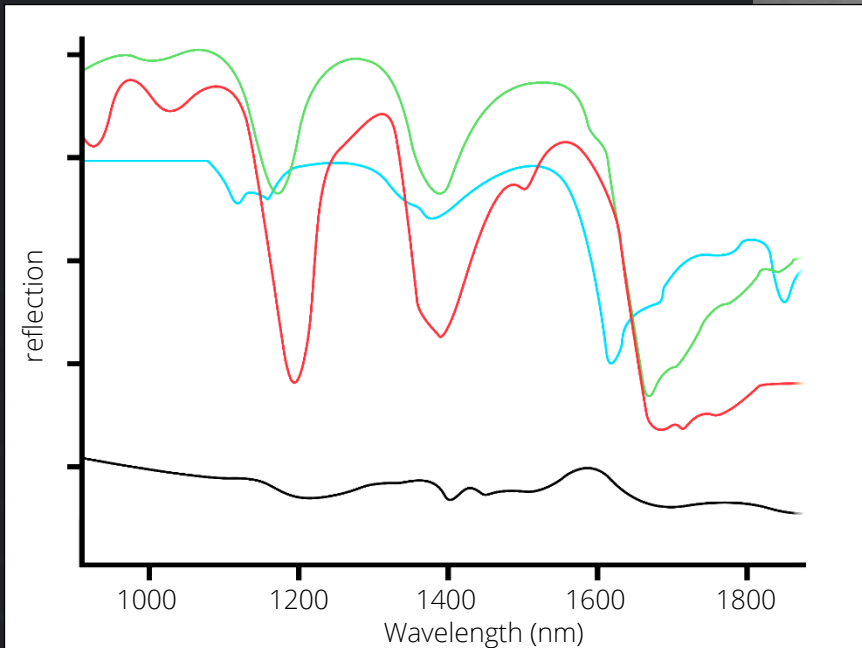
The interaction depends on the specific wavelength in combination with the material it radiates on. With a photo sensor (CCD/CMOS) this interaction can be recorded.

Practical use of NIR

This picture was made in the Near Infrared spectrum.

What is the color of these plastic bottles?





Practical use of NIR

If a plastic is pigmented correctly, it reflects NIR radiation. Based on the reflection of different wavelengths, a computer can identify the specific “signature” of the plastic so it can be sorted for recycling.

Some bottles are pigmented in such a way they almost have no reflection in the NIR spectrum and therefore they cannot be identified in automated sorting machines used in plastics recycling.



Practical use of NIR

Carbon-black pigment is an example of a pigment that causes the plastic bottles not to be recognized by recycling equipment.

Recently some large masterbatch suppliers introduced black pigments with enough reflection in the Near Infrared spectrum so that the products can be recycled

The pictures above show a traditional black plastic bottle and a bottle with the new black pigment that does reflect NIR.



Picture taken in visible light



Picture taken in Near Infrared

Practical use of NIR

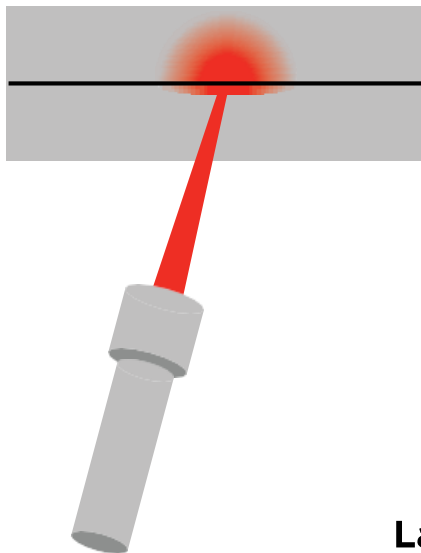
These pictures show a bottle with a strip that is transparent in the visible spectrum set in a plastic that is opaque in the visible spectrum. Both however are transparent in the Near Infrared spectrum, although one is more diffuse than the other.

Answering customer request

A machine vision level check is possible in this way but the resulting image is not yet clear enough solve the challenge set by our customer.



Picture taken in visible light



Absorbing
Transmissive

Laser welding

Customer request

To answer the customers request, the issue of clarity needs to be solved.

Looking at a cross over from laser welding pigmentation helps us to select a polymer with a high clarity in the NIR spectrum. In laser welding this is important so that the transmissive layer has no unwanted heat-up.

Achieving this high clarity is dependent on both the base material molecular structure as well as the specific pigmentation.



Picture taken in Near Infrared



Picture taken in visible light

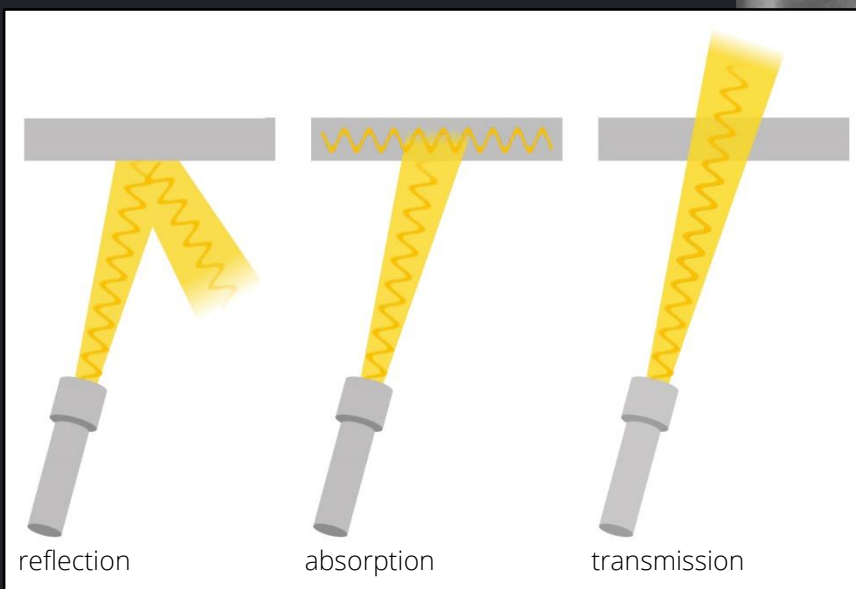
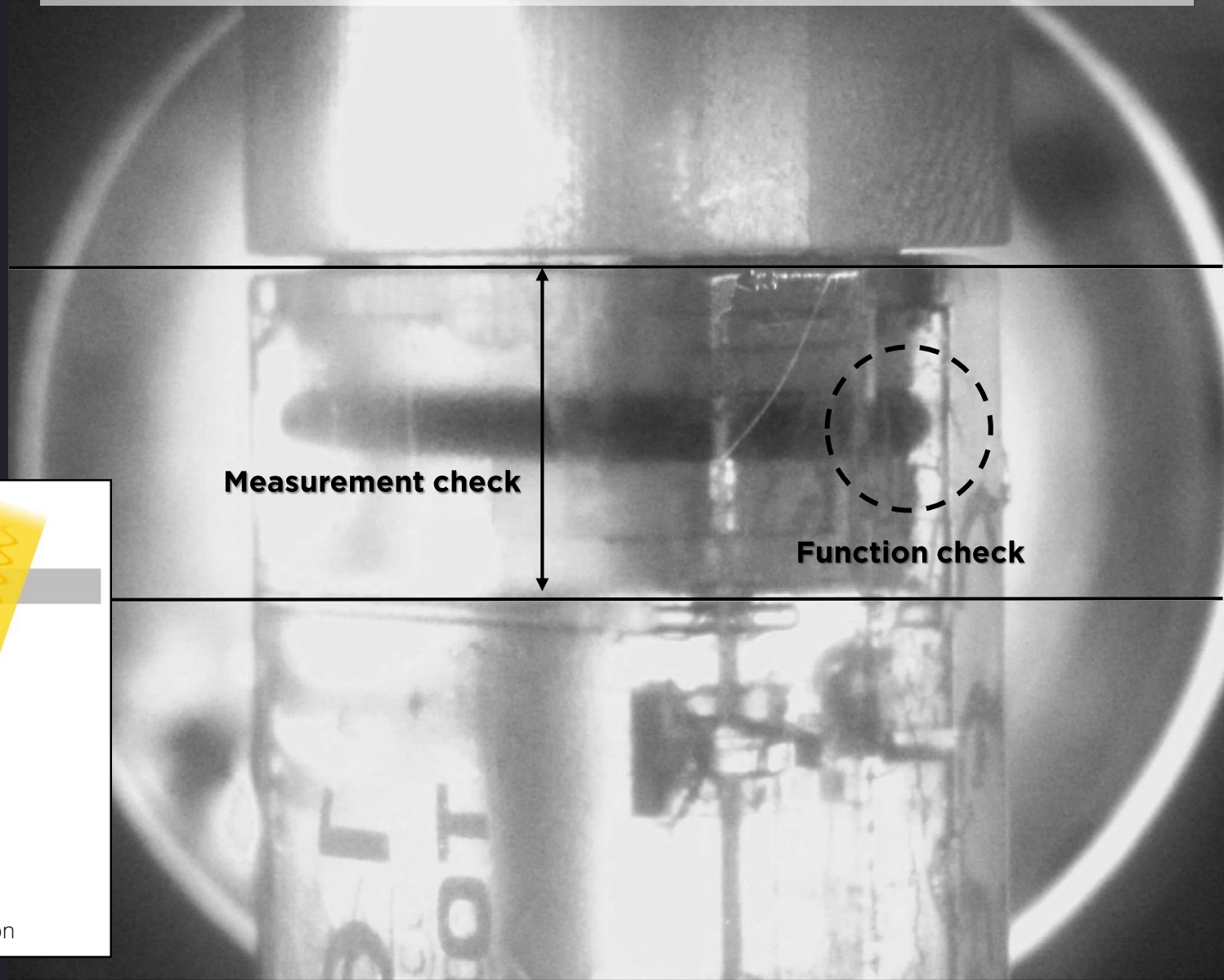


Picture taken in Near Infrared

Selecting the right material as well as the right pigmentation results in a product that is opaque in the visible spectrum but clear transparent in the Near Infrared spectrum.



Next to the possibility to check the level of liquids in closed containers, the clarity of the resulting images also makes it possible to do assembly verification and dimensional checks during the assembly process.





Customer request:

Investigate the possibilities of visually checking inside an opaque polymer assembly without damaging it.

TRICAS

Answer:

Selecting the right material as well as the right pigmentation results in a product that is opaque in the visible spectrum but clear transparent in the Near Infrared spectrum.

The resulting technology can be implanted in a machine assembly line. The resulting high quality pictures can nowadays also be achieved with low cost consumer electronics.

Lecture held by Paul Voerman at the Kunststoffenbeurs 2019 in Veldhoven.

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