

R E P O R T

Infrared-optical investigations of three samples

**commissioned by
SA.ME. Srl**

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Subject of investigation: IR-optical investigations of three samples

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Number of **Pages:** 8

Figures: 3

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1 Aim of the Investigation

The aim of the investigation is to determine the infrared emittance of three samples (Tab. 1) in the spectral region between 1.4 μm and 35 μm . The samples were measured at different positions to test their homogeneity.

Tab. 1: Survey of the measured samples, which were provided by SA.ME..

sample	description
1	Alluminio polietinato
2	Alluminio puro
3	PET metallizzato

2 Theoretical Background

2.1 Determining the spectral emittance ε_λ

First, the spectral directional-hemispherical reflectance R_{dh} and transmittance T_{dh} of the samples were measured at room temperature, using a FTIR – spectrometer (Fourier Transform Infrared Spectrometer) (Fig.1) and an integrating sphere (Fig. 2). The inner side of the integrating sphere and the standard are coated with a diffusely reflecting gold sheet. Several measurements at different places were performed to test the homogeneity of the fabrics. The spectral emittance ε_λ can be calculated from the spectral directional-hemispherical reflectance R_{dh} and transmittance T_{dh} :

$$\varepsilon_\lambda = 1 - R_{\text{dh}} - T_{\text{dh}} \quad . \quad (1)$$

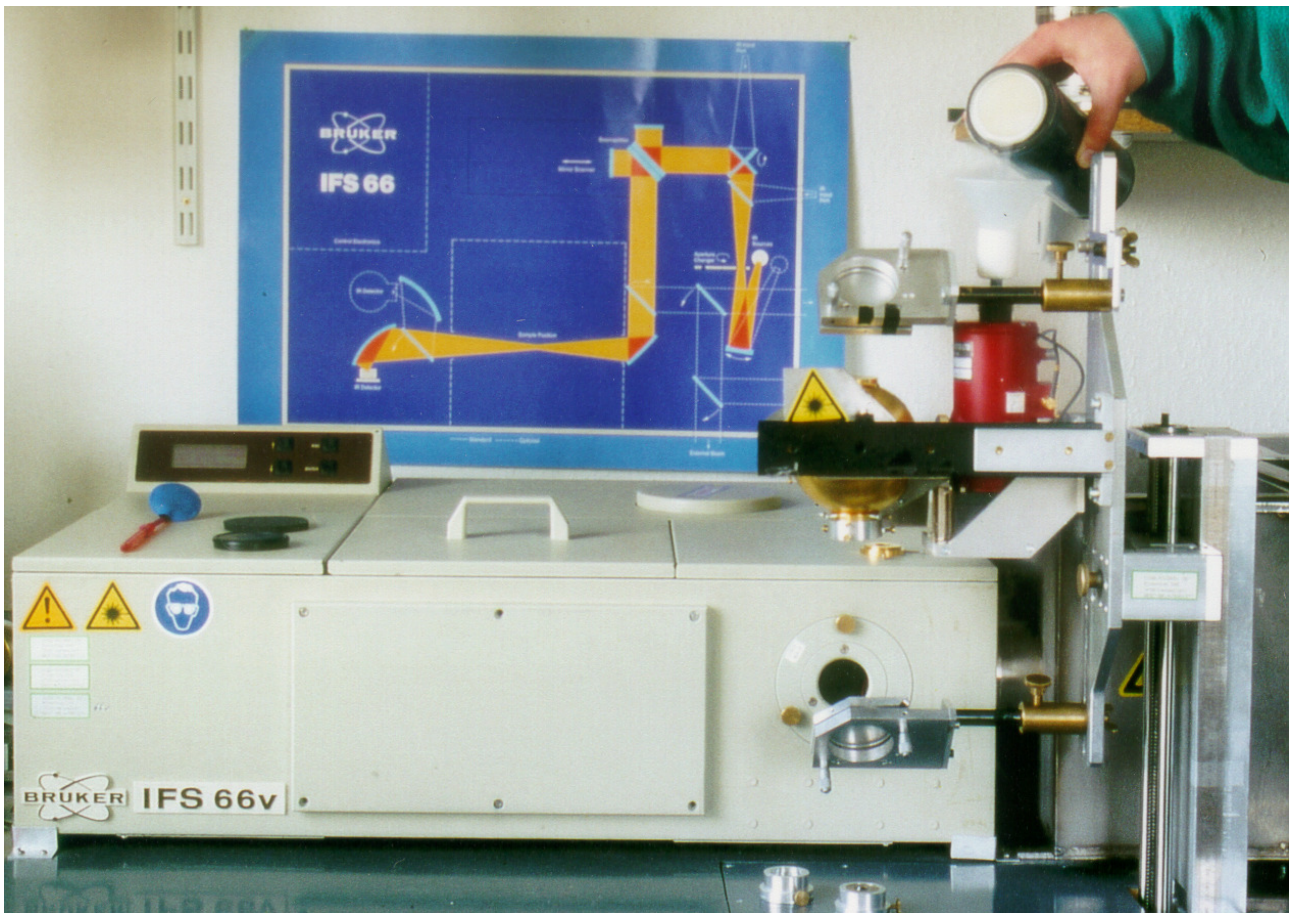


Fig. 1: FTIR (Fourier Transform Infrared) - spectrometer FFS 66v from Bruker. On the right side in front of the spectrometer an integrating sphere with detector is visible. The beam path is depicted behind the spectrometer. To avoid the influence of air, the spectrometer is evacuated.

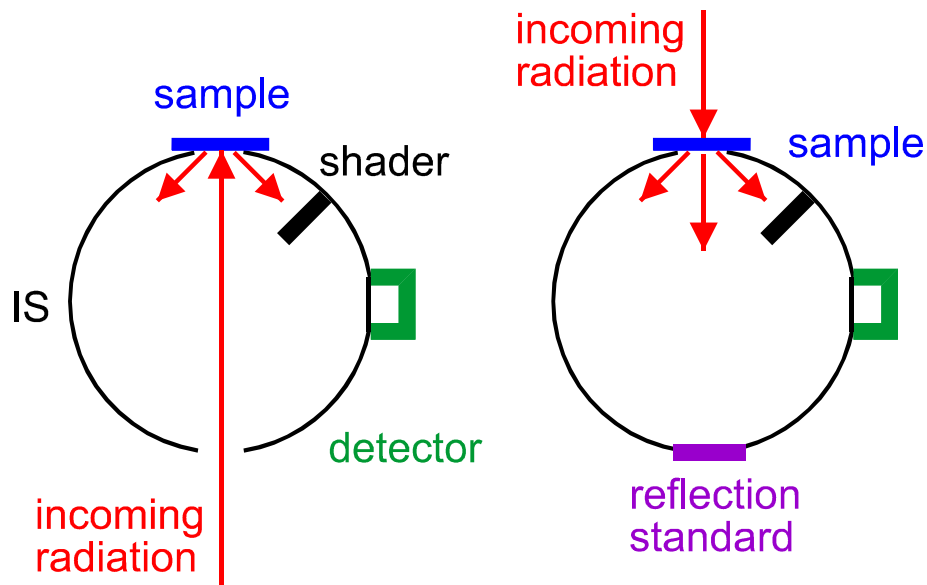


Fig. 2: Measurement of the directional-hemispherical reflectance R_{dh} (on the left side) and of the directional-hemispherical transmittance T_{dh} (on the right side) with an integrating sphere.

The samples were measured with a FTIR-spectrometer from Bruker in the wavelength range between $1.4 \mu\text{m}$ and $35 \mu\text{m}$. The total emittance $\varepsilon(T)$ was then derived from the spectral emittance ε_{λ} as described in Chapter 2.2

2.2 Determining the infrared emittance ε_{IR}

From now on the infrared emittance ε_{IR} is called total emittance $\varepsilon(T)$.

Every surface emits radiation due to its temperature. The total emittance $\varepsilon(T)$ gives the amount of energy that is emitted by the surface. The total emittance $\varepsilon(T)$ with respect to the temperature T can be calculated by integrating the spectral emittance ε_{λ} over all wavelengths with the Planck-function $i_{\lambda}(T)$ as a weight function:

$$\varepsilon(T) = \frac{\int_{1.4}^{35} \varepsilon_{\lambda}(T) \cdot i_{\lambda}(T) \cdot d\lambda}{\int_{1.4}^{35} i_{\lambda}(T) \cdot d\lambda} \quad . \quad (2)$$

The Planck-function $i_{\lambda}(T)$ gives the intensity emitted by a black body at a certain temperature T . At room temperature, the wavelength range between 1.4 μm and 35 μm is significant.

3 Results

The transmittance of the three samples is equal to zero in the investigated spectral range. The reflectance at different positions is quite the same, for all three samples. The spectral emittance ε_λ of the investigated samples is depicted in Fig. 3 as a function of the wavelength. The resulting total emittance $\varepsilon(T)$ and the hemispherical total emittance $\varepsilon_h(T)$, calculated in accordance with DIN EN 12898, is given in Tab. 2 for $T = 300$ K.

Tab. 2: Total emittance ε of the three samples.

sample	total emittance $\varepsilon(T)$ at $T = 300$ K	hemispherical total emittance $\varepsilon_h(T)$ at $T = 300$ K
1	0.29 ± 0.03	0.31 ± 0.03
2	0.06 ± 0.03	0.07 ± 0.03
3	0.03 ± 0.03	0.04 ± 0.03

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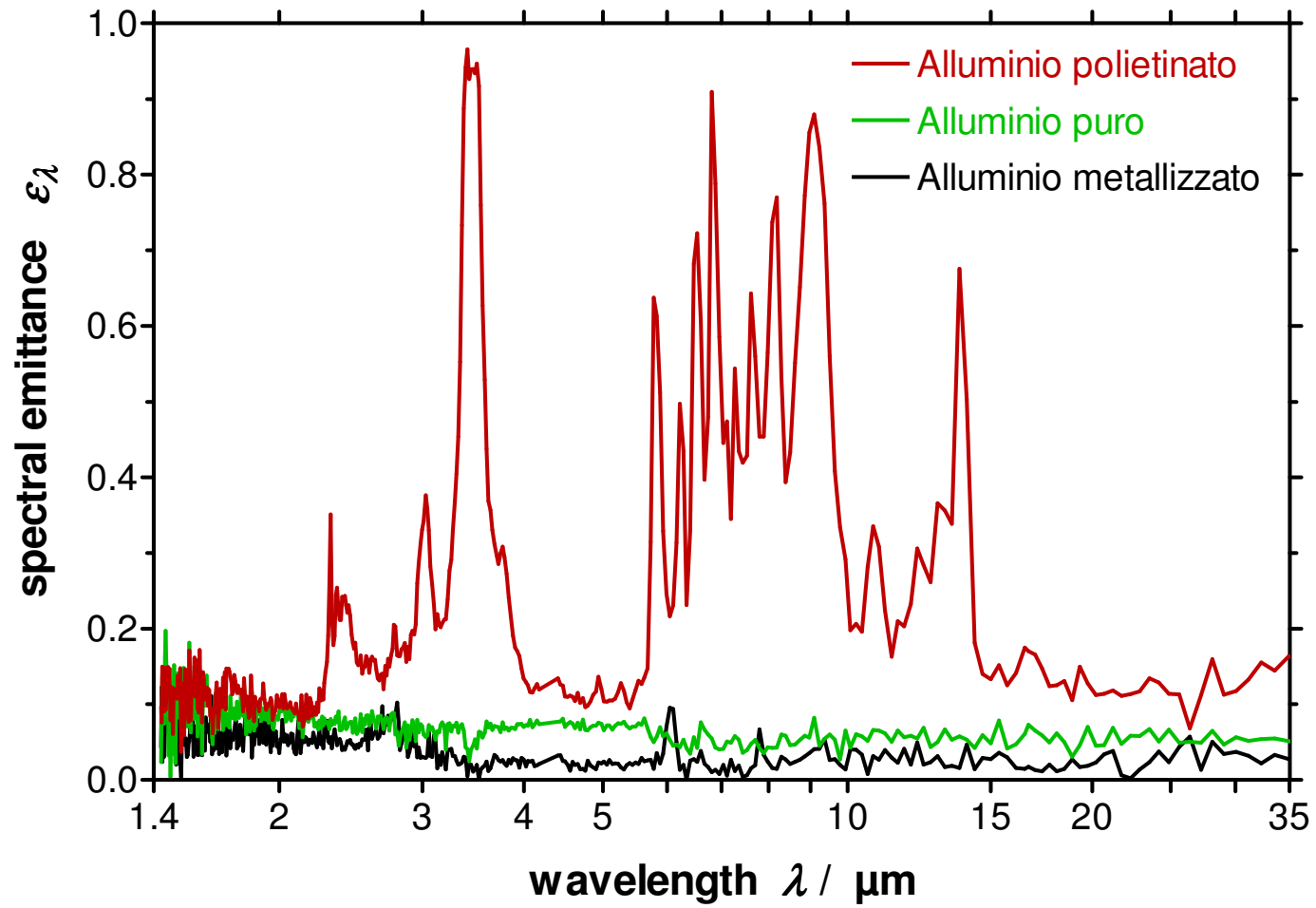


Fig. 3: Spectral emittance ϵ_λ of the investigated samples in the wavelength range between 1.4 μm and 35 μm .