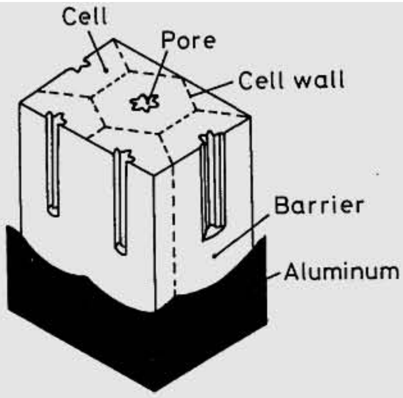

Fig. 1. Schematic view of pore, cell, cell wall, and barrier of alumina made by anodic oxidation of aluminum.[1]

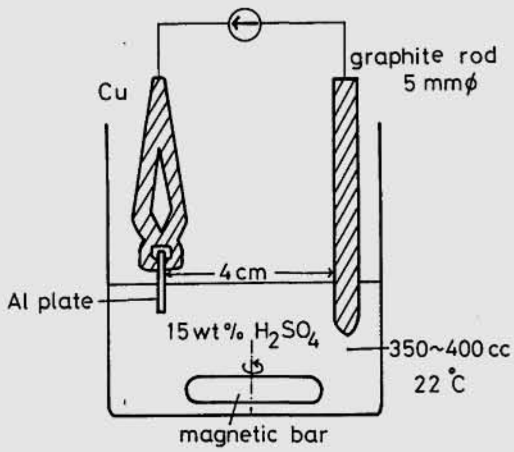

Fig. 2. Apparatus for anodic oxidation.

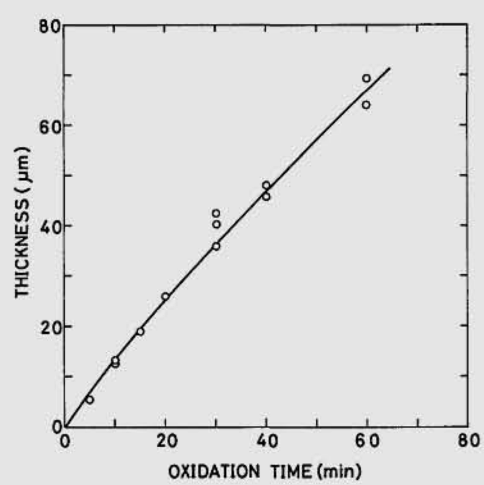

Fig. 3. Thickness of alumina as a function of oxidation time.

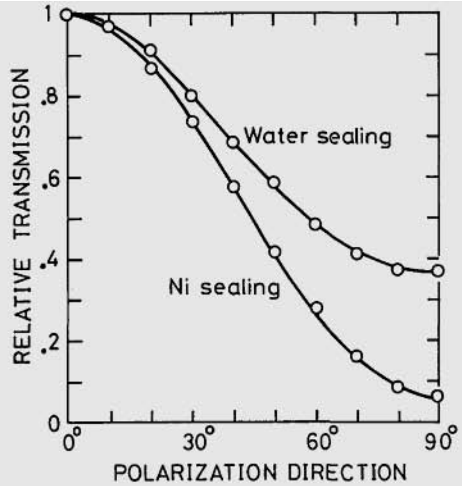

Fig. 4. Polarization properties of an alumina thin-film waveguide sealed by hot water or nickel.

metal sealing is larger than that for water sealing, which suggests the possibility of fabricating a short length polarizer or some kind of functional device.

Summarizing: preliminary experiments have been conducted to show the possibility of fabricating alumina functional devices using the technique of anodic oxidation and a sealing process.

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Display of the local spectrum: a pseudocoloring approach

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The color encoding of information is in many cases a useful operation in image processing, taking into account the human eye's ability to better discriminate colors than gray levels. In recent years, several optical methods employing spatial or temporal filters were proposed for pseudocoloring object transparencies either in the space domain or in the spatial frequency domain.[1–5] In this last case, the processed image exhibits a color pattern in accordance with the spatial

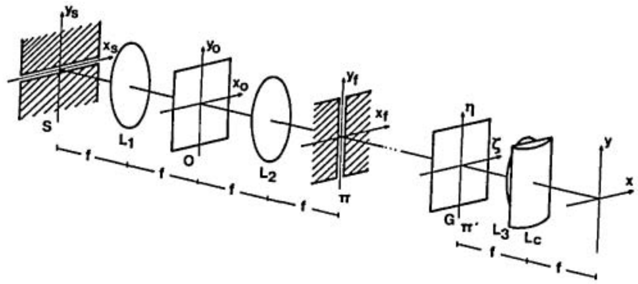

Fig. 1. Scheme of the optical setup: L_1, L_2, L_3, spherical lenses; L_c, cylindrical lens; S, polychromatic light source; O, input object; G, filter mask. π and π' denote the input and output planes of the spectroscopic device.

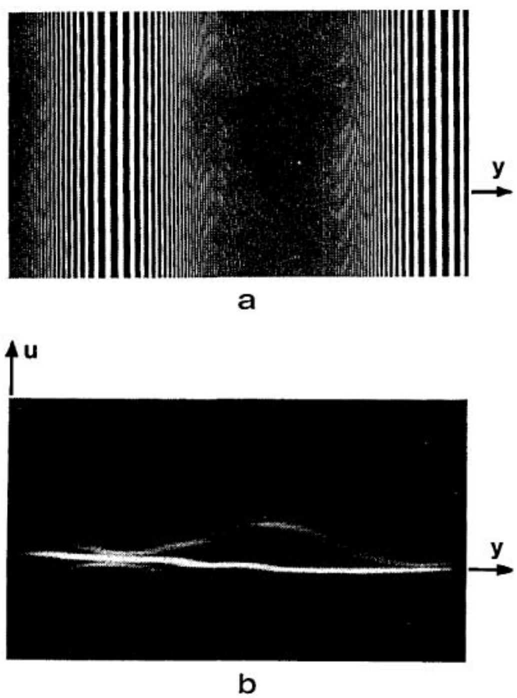

Fig. 2. (a) Test object: sinusoidal frequency modulation; (b) associated local spectrum $W_f(y;u)$.

frequency content at each point of the image. Another way to display the same information is by means of the local spectrum, which is a space-phase representation of the object signal.[6,7] Hence it seems apparent that the optical methods developed for pseudocolor encoding the spectral content of a certain input object can also be adapted to achieve its local spectrum or complex spectrogram. In this Letter we propose an optical setup for obtaining a pseudocolor display of the local spectrum associated to 1-D transparencies, which can be easily modified to perform a spatial frequency pseudocoloring. For this last purpose, Bartelt suggested a similar optical arrangement.[4]

The system to be discussed is shown in Fig. 1. The Fourier transform of the 1-D object $f(y_0)$, wavelength multiplexed, is formed into the slit of a spectroscopic device, so obtaining in the conjugate plane several replicas of the object spectrum for different wavelengths. An amplitude filter placed in such a plane selects for each wavelength a portion of the object spectrum $F(u)$. Then a cylindrical lens performs a 1-D Fourier transform so that the intensity at the output plane becomes

$$I(x,y) = \left| \int_{-\infty}^{\infty} F(\eta)G(\eta - \alpha\lambda) \exp(2\pi i \eta y) d\eta \right|^2, \tag{1}$$

where $G(\eta)$ is the amplitude transmittance of the filter. Besides, $x = \alpha\lambda$, α being proportional to the dispersion of the prism or grating employed. The intensity distribution, as given by Eq. (1), depicts the local spectrum $W_f(y;u = \alpha\lambda)$ of the input signal $f(y_0)$. Thus the wavelength axis stores the spatial frequency content of each part of the image (y axis). To illustrate the method, we use a test object $f(y_0)$ which consists of a cosine grating whose frequency varies sinusoidally. As shown in the Fig. 2, the local spectrum representation exhibits very clearly the spatial frequency variation (as color change) depending on position. In this case, we employed as a filter function $G(\eta)$ a narrow slit in-plane rotated by a certain angle θ so as to pseudocolor encode the whole spectral content of the object.

As a final remark, it is worthwhile to consider which of both operations, spatial frequency pseudocoloring or local spectrum display, is preferable for a given application. If we are interested in small localized defects (as occurs in texture analysis), it seems more appropriate to perform a spatial frequency pseudocoloring as processing operation. On the other hand, if the test object shows a slow rate of spatial frequency change, the local spectrum provides a better representation.

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