

PHY22 Phase shift and resonance effects



In the experiment, ultrasonic signals from reflections at boundaries of different materials are recorded and analysed regarding their phase position. Furthermore, the influence of thin layers upon the reflection and transmission of ultrasonic waves is investigated using $\lambda/4$ and $\lambda/2$ plates.



Related topics

Reflection, transmission, reflection coefficient, characteristic acoustic impedance, phase shift, $\lambda/4$ and $\lambda/2$ layer

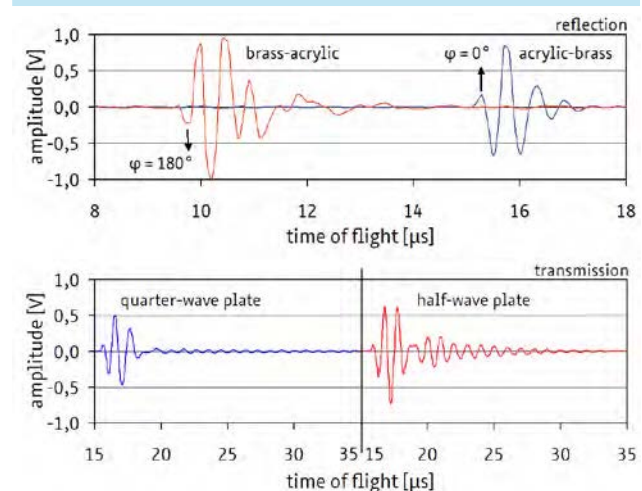
If a plane ultrasonic wave from a medium with the characteristic acoustic impedance Z_1 strikes a plane boundary to a second medium with the impedance Z_2 , it is partially or completely reflected on this. The reflected part of the sound energy depends on the ratio of the impedances and is described by the reflection factor. The reflected wave generally also has another phase. In the case of perpendicular sound incidence, the phase change only takes two values: 0° for $Z_1 < Z_2$ and 180° for $Z_1 > Z_2$. Based on such a phase shift, the impedance ratio of two adjacent materials can be qualitatively described. Particularly interesting effects occur when sound passes through thin layers, the thicknesses of which are a quarter or a half of the sound wavelength. $\lambda/4$ layers are used e.g. as matching layers in order to minimise reflections and to transfer the largest possible share of sound energy from one medium into the other medium.

Equipment

Ultrasonic echoscope GS200	10400
2 ultrasonic probes 1 MHz	10151
Ultrasonic probe 2 MHz	10152
Test cylinder set	10207
Acoustic impedance samples	10208
Lambda plates	10209
Ultrasonic gel	70200

Results

The first graphic shows echo signals from an acrylic-brass and brass-acrylic boundary with perpendicular sound incidence. The characteristic acoustic impedance $Z = c \rho$, determined from the sound velocity c and the material density ρ , was 36.8 Mrayl for brass and 3.25 Mrayl for acrylic. The second graphic shows measurements in transmission at an acrylic cylinder. Each time, a thin aluminium plate ($c_l \approx 6309$ m/s) with a thickness of $\lambda/4$ (approx. 1.5 mm) and/or $\lambda/2$ (approx. 3.1 mm) was arranged between the transmitting probe and the cylinder.



Related experiments

PHY05 Spectral investigations

PHY21 Reflection and transmission at boundaries