IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO - IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

A METHOD OF MANUFACTURING A SLIT MASK FOR IN-SITU LASER ULTRASONIC INSPECTION OF ADDITIVELY MANUFACTURED COMPONENTS

IITM Technology Available for Licensing

Problem Statement

- Conventionally available **slit masks are not flexible** where such slit masks are made from thin sheet metals that are glued which can eventually fall off.
- Thin masks will **deform in time,** thereby changing the desired wavelength.
- A number of processes are involved conventionally for implementing the masks for inspection which are **time consuming and expensive**
- Therefore, there is an unmet need for slit masks with **improved flexibility, time/cost effectiveness and efficiency.**

Technology Category/ Market

Category: Additive Manufacturing, Non Destructive Testing
Applications: Medical imaging, Advance materials, Test Equipment's , NDE
Industry: Manufacturing, Healthcare, automotive, Aerospace & Defence
Market -The global additive manufacturing market size was valued at USD 13.84 billion in 2021 and is expected to expand at a compound annual growth rate (CAGR) of 20.8% by 2030

TRL (Technology Readiness Level)

TRL-3 Experimental Proof of concept

Intellectual Property

- **IITM IDF Ref.1685**
- **IN 420162 (Granted)**

Research Lab

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Technology

The present technology involves method for **efficiently generating and/or mixing laser generated narrowband ultrasonic waves using an integrated or permanent slit mask.**
Method:

- ❑ Scanning the powder or a wire with laser to form a printed desired **3D component**
- ❑ Scanning the powder or a wire with a laser to form a printed desired **3D slit mask**

The method is given by the following steps:

Providing a powder bed of selected powder on a substrate

↓

Scanning the powder with laser, forming a melt pool

↓

Fusing the powder onto a desired shape to form a first layer of component

↓

Formation of a subsequent layer

↓

Replenishing and repeating to form final desired 3D component and separate from substrate

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The system includes:

a) A non-contact energy source for localized heating in the additively manufactured component to generate ultrasonic waves;

b) An ultrasound receiver for receiving the ultrasonic waves;

c) An instrument to display the signals.

d) A computer to process the signals.

Fig.1 Represents a schematic view of the additive manufactured integrated slit mask concept .

Fig.2 is photograph of additively manufactured test specimen with the integrated slit mask

Fig.3 is an An illustration (top view) of a combinational dual wavelength slit mask for wave mixing

Fig 4 is an illustration of a possible configuration for Lamb wave mixing using slit masks

Fig 5 is graph showing signal in frequency domain clearly showing the fundamental and higher harmonics

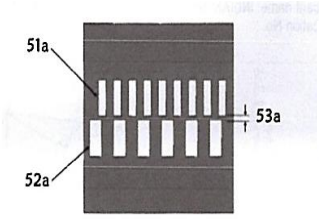

Fig. 3

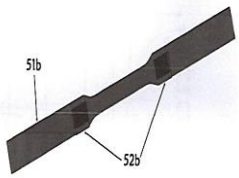

Fig. 4

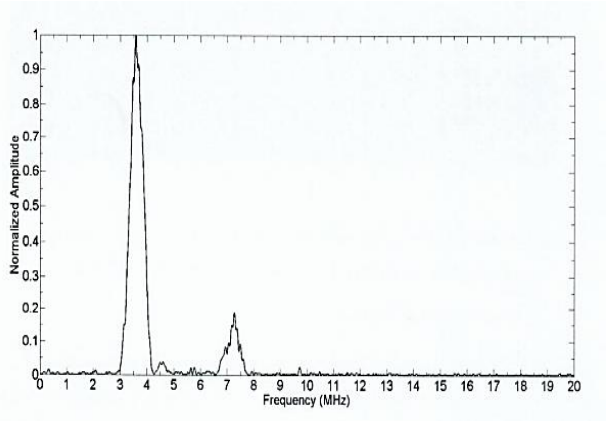

Fig. 5

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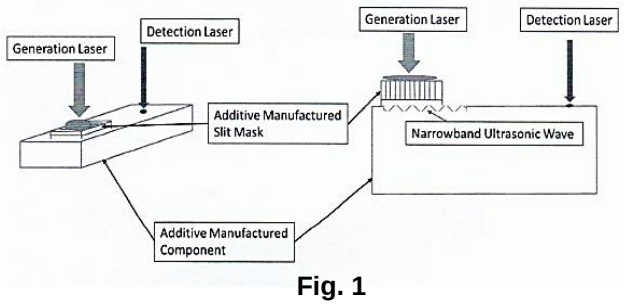

Fig. 1

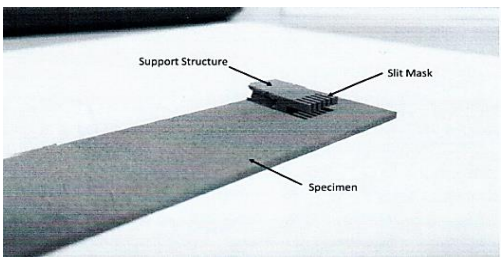

Fig. 2

Key Features / Value Proposition

- It is possible to **carry out wave mixing (both linear and non-linear)** using a single mask or using masks located at different locations.
- **Less deformation** compared to conventional slit masks, hence, almost constant wavelength is generated throughout the lifetime of the mask
- **Precise frequency generation** by controlling the width of the slit
- **Generation of higher harmonics** (peak signal ~7.2Hz)
- Has an **improved flexibility** unlike the conventional systems where the slit mask is custom made
- **Time/ cost effectiveness** and efficiency and occupies less space

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