DEVELOPMENT OF AN ECONOMICAL SILICON SOLAR CELL

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$114,100

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ABSTRACT

The purpose of this project is to investigate a method of growing electronically viable silicon films on inexpensive foreign substrates, with the objective of creating a technology to radically reduce the overall cost of the silicon employed in photovoltaic solar energy conversion.

The approach employed is to enhance crystalline ordering during film nucleation by confining arriving silicon atoms to a narrow band traveling across a substrate, i.e., the Lateral Growth Technique (LGT). The efforts have employed physical vapor deposition of silicon in a vacuum evaporator on glass and metal substrates with both slit masks and single defining edges, and subsequent chemical vapor deposition (CVD) of thicker films on these thin film structures by pyrolysis of silane at higher temperatures. Efforts will continue on optimizing grain size and film-substrate compatibility for utilization of relatively conventional solar cell processing techniques and temperatures.

The key results to date are: improved ordering with LGT, even using single-edge masking of the silicon flux and reasonable growth rates with the LGT-CVD combination.

OBJECTIVES

ELECTRONICALLY VIABLE SILICON ON DISORDERED SUBSTRATES

- MINIMUM SILICON USAGE
- INEXPENSIVE SUBSTRATE
- CONTINUOUS OPERATION POSSIBILITIES

APPROACH

LATERAL GROWTH TECHNIQUE (LGT) FOR ORDERING

COMBINE LGT & CHEMICAL VAPOR DEPOSITION (CVD) FOR THICKNESS

METAL SUBSTRATE FOR BACK CONTACT

LAST 6 MONTHS ACTIVITY

LGT DEPOSITIONS ON VARIOUS SUBSTRATES & COATINGS

DEPOSITION RATE INVESTIGATIONS

DEPOSITIONS WITH SLITS & SINGLE EDGES

CVD APPARATUS INSTALLATION

COMBINED LGT - CVD DEPOSITIONS

LGT SILICON COST POTENTIAL

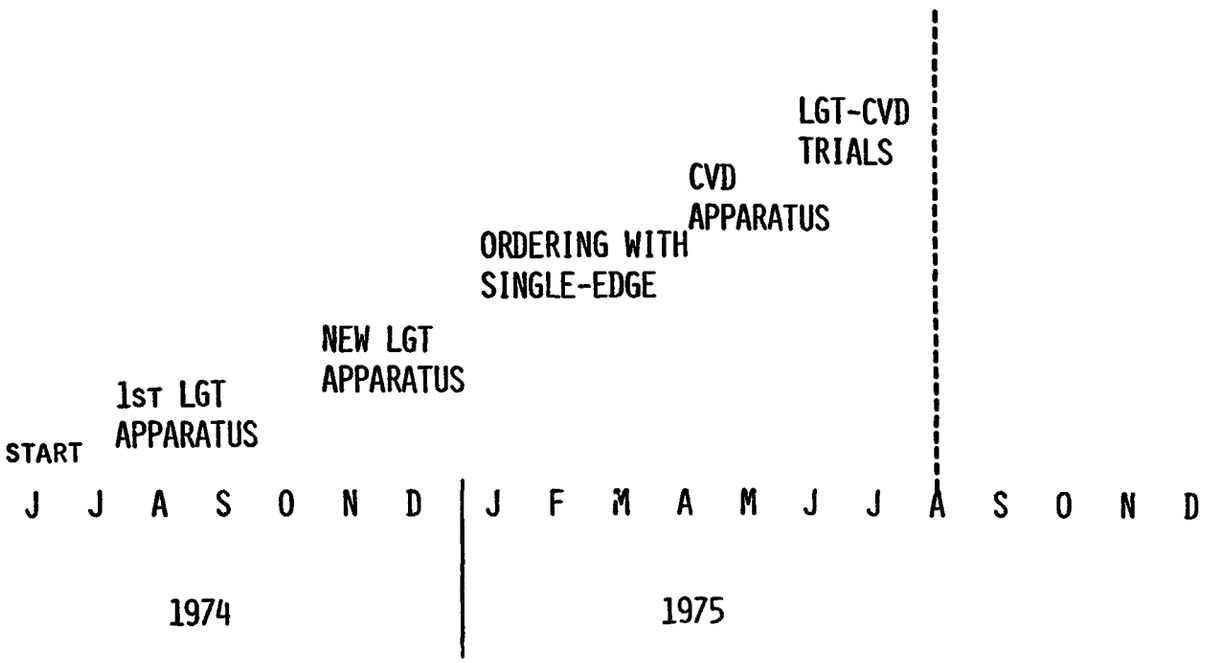
PRESENT CZOCHRALSKI : 250 MICRON THICK--$25/SQ.FT. ($270/SQ.M.)

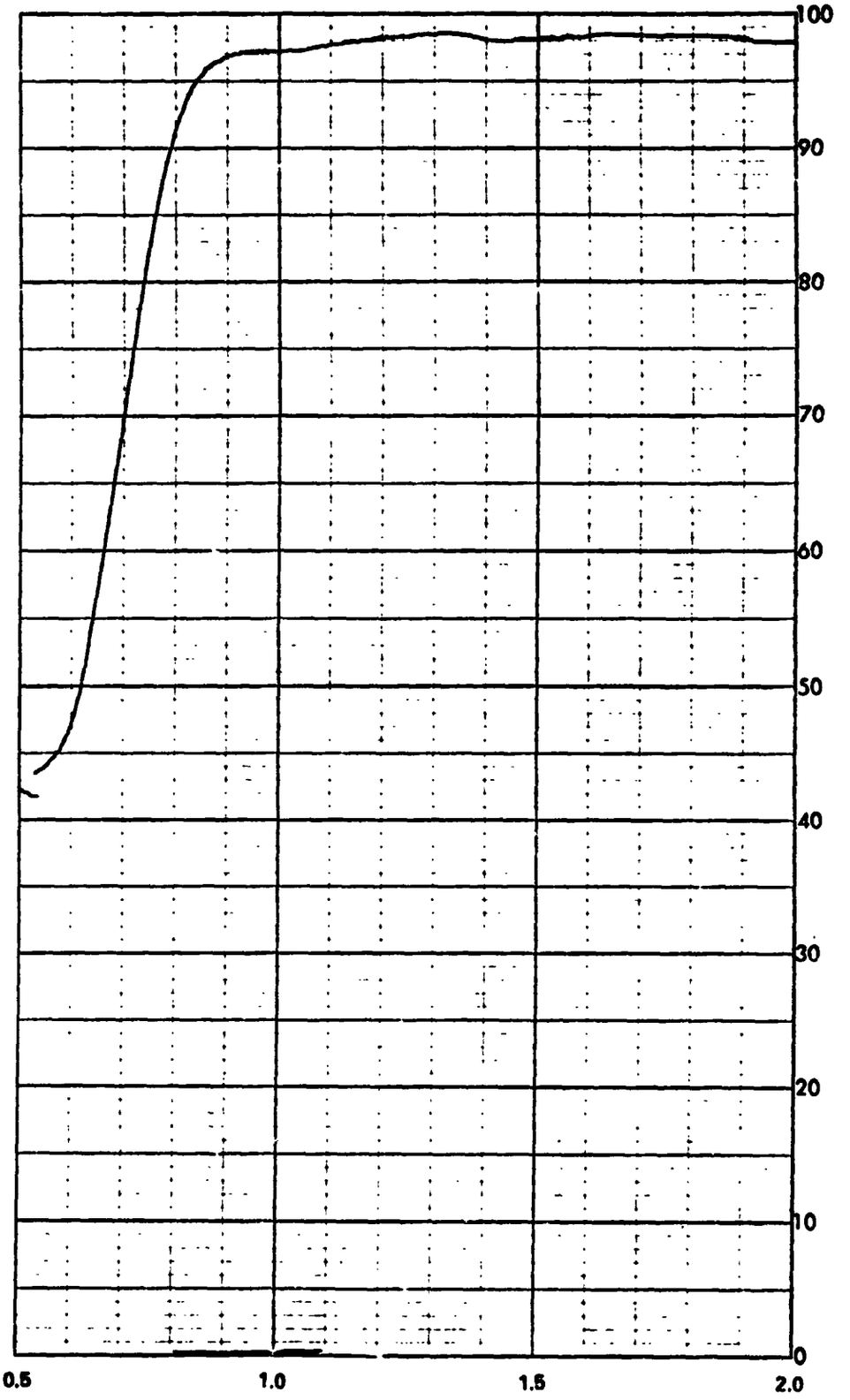
LGT-CVD

CLAD SUBSTRATE----------15¢/SQ.FT.
LGT SOURCE, POLY-Si---------- 5¢/SQ.FT.
TRICHLOROSILANE FOR 50 MICRONS-----50¢/SQ.FT.

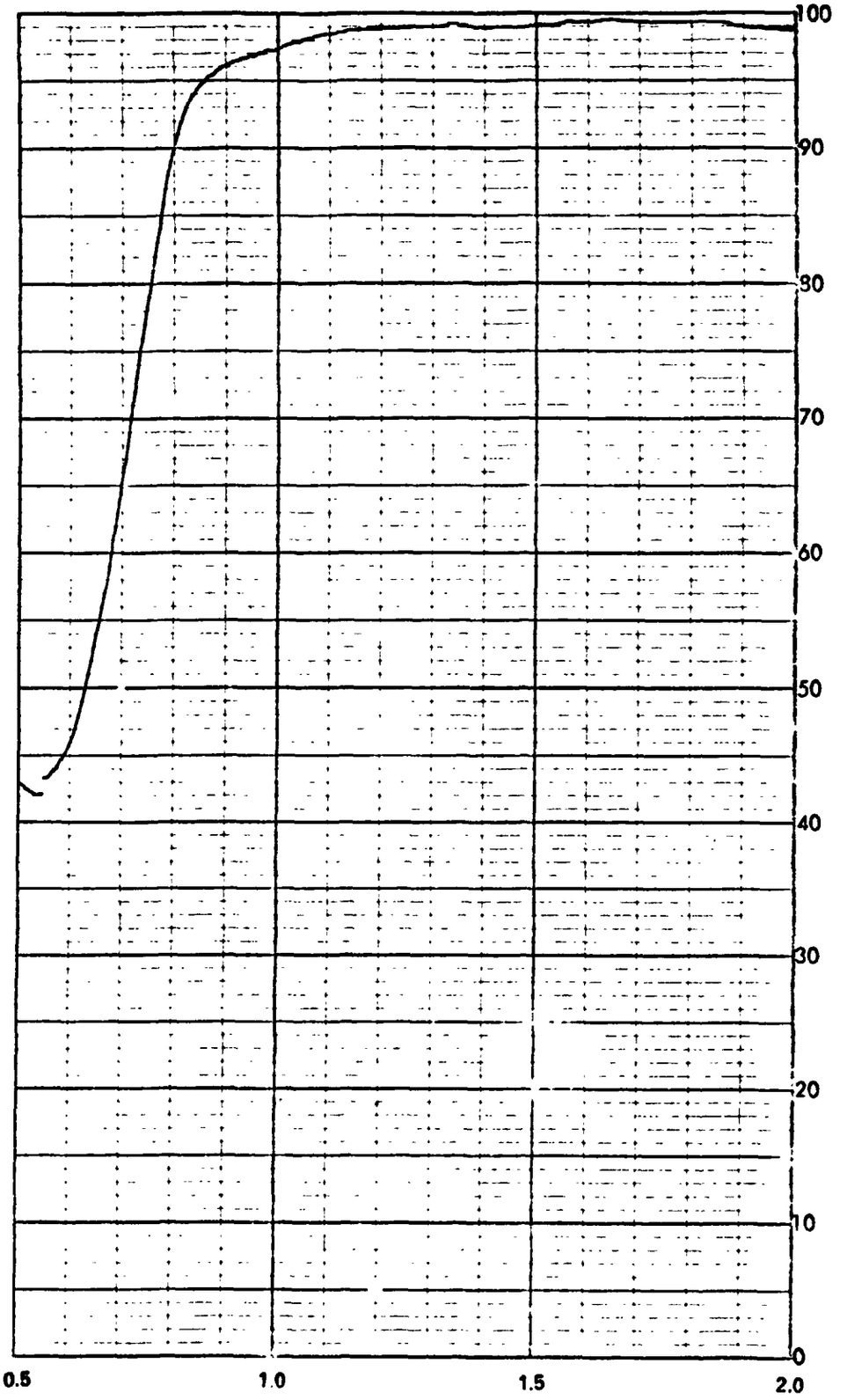
TOTAL--------70¢/SQ.FT. ($7.50/SQ.M.)

LGT SILICON TIMETABLE

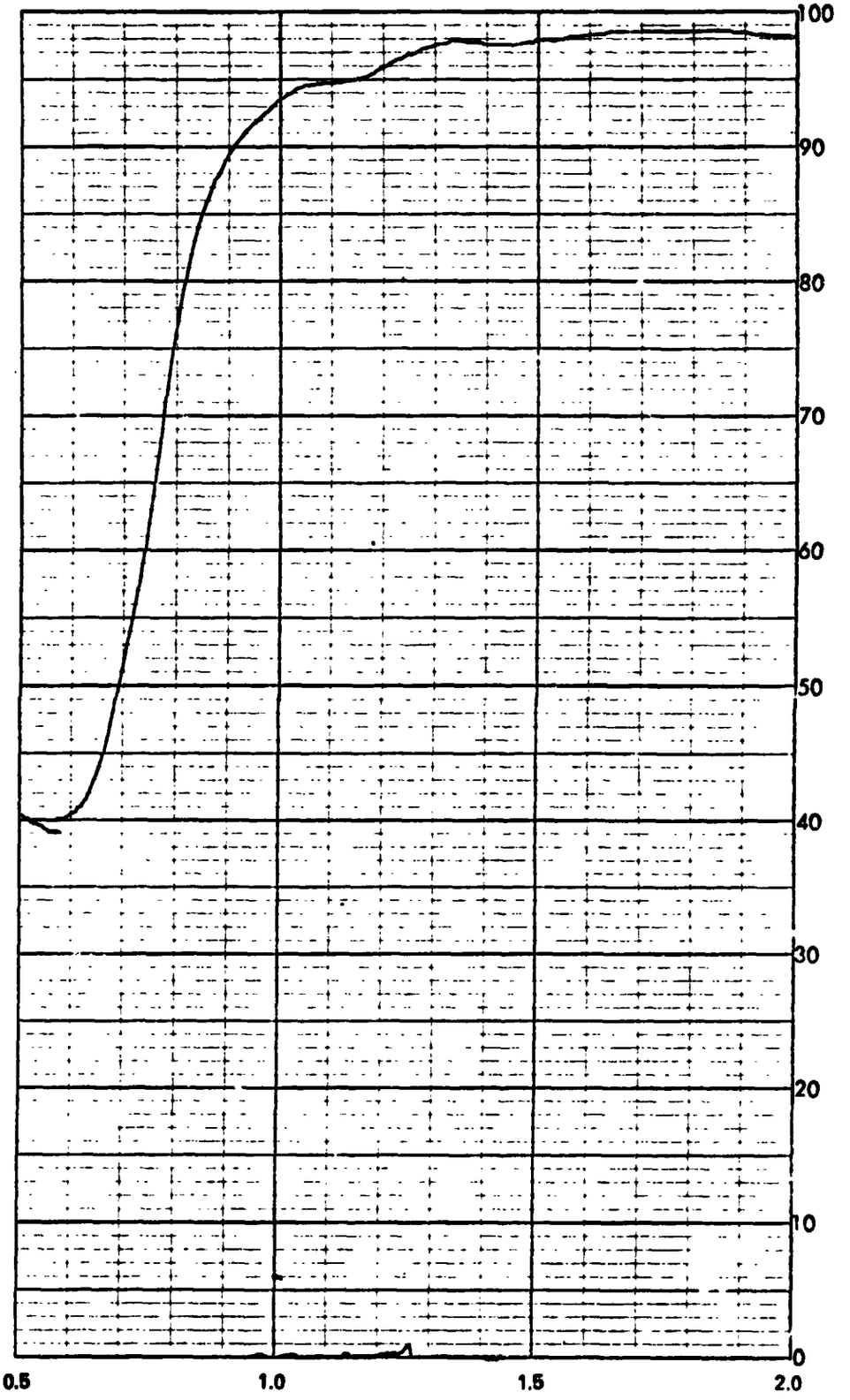




Single edge with slower travel and lowered deposition ra'.e.

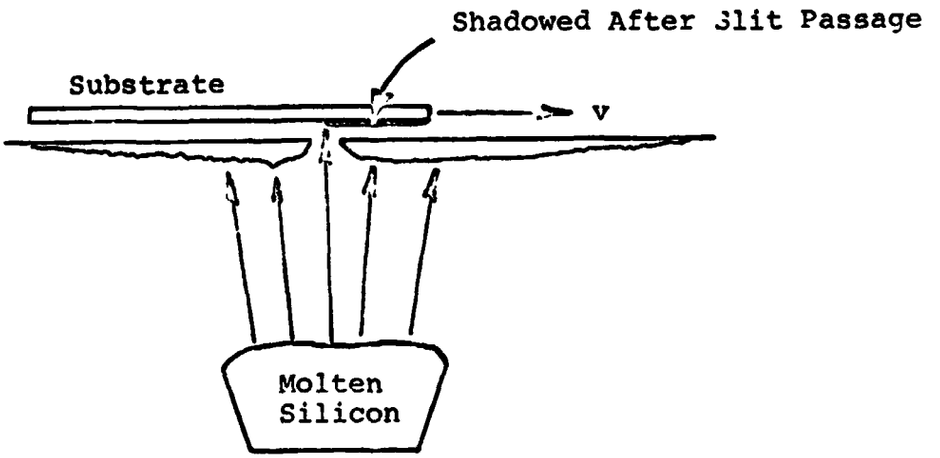


Slit deposition with slower substrate travel.

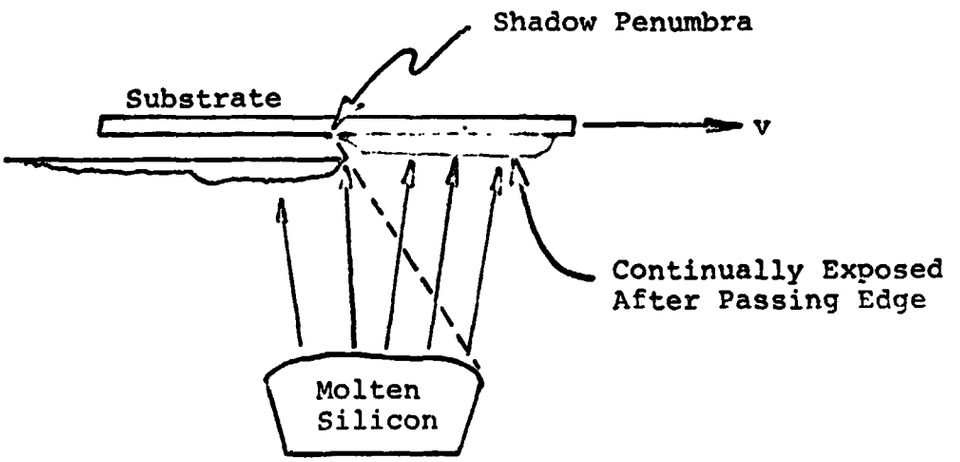


Optical reflection + transmission for LGT silicon film deposited through a slit onto glass.

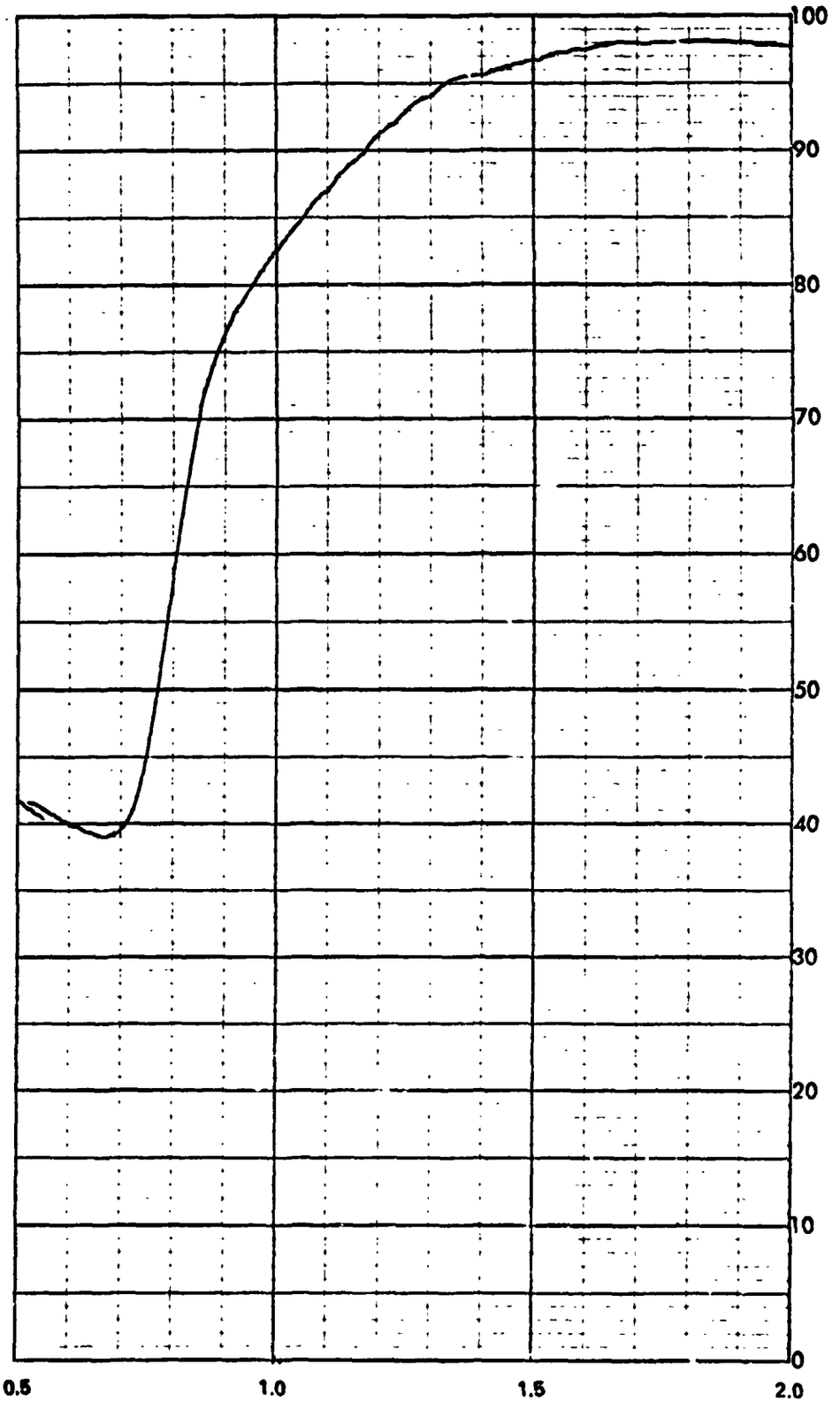
Slit Deposition



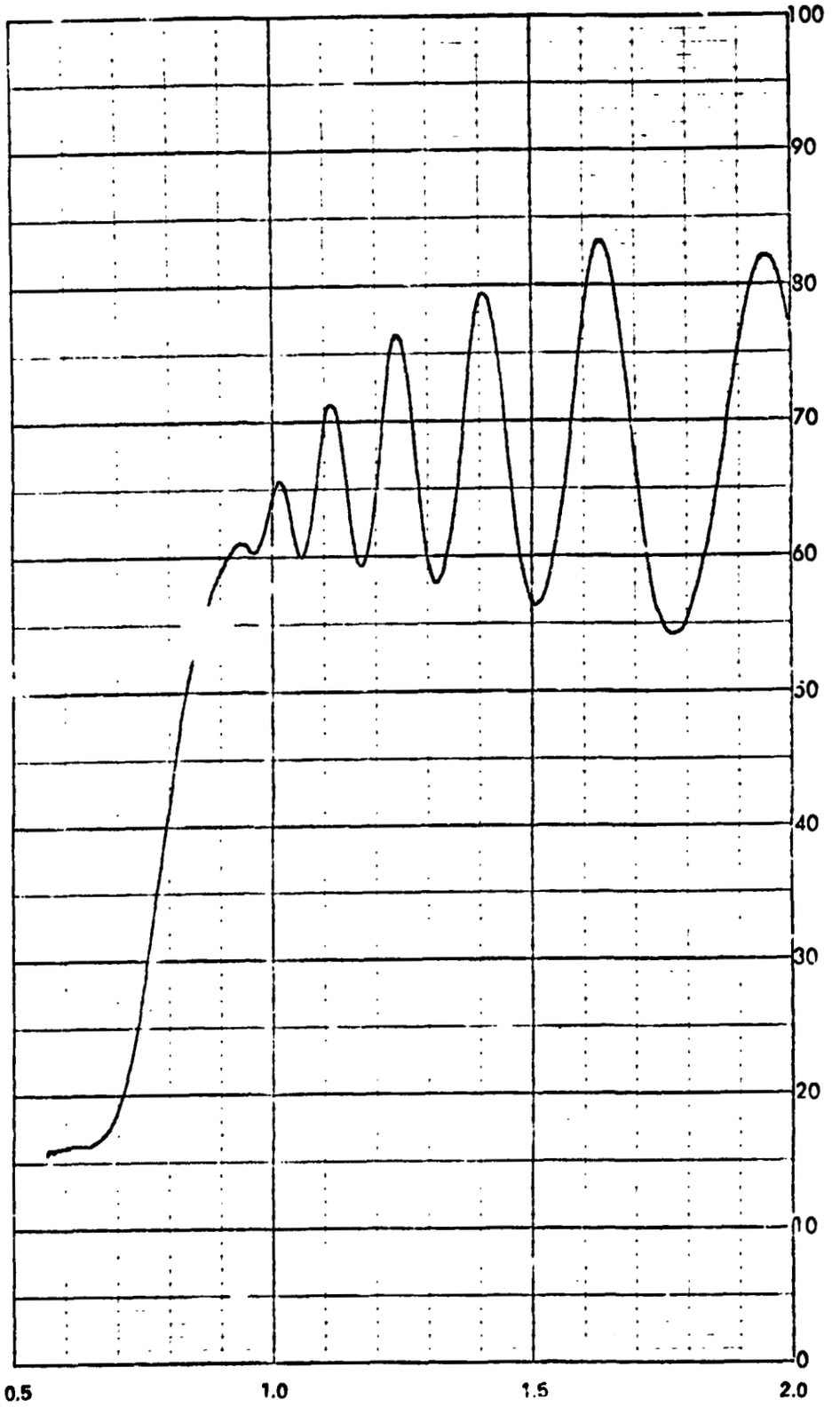
Single-Edge Deposition



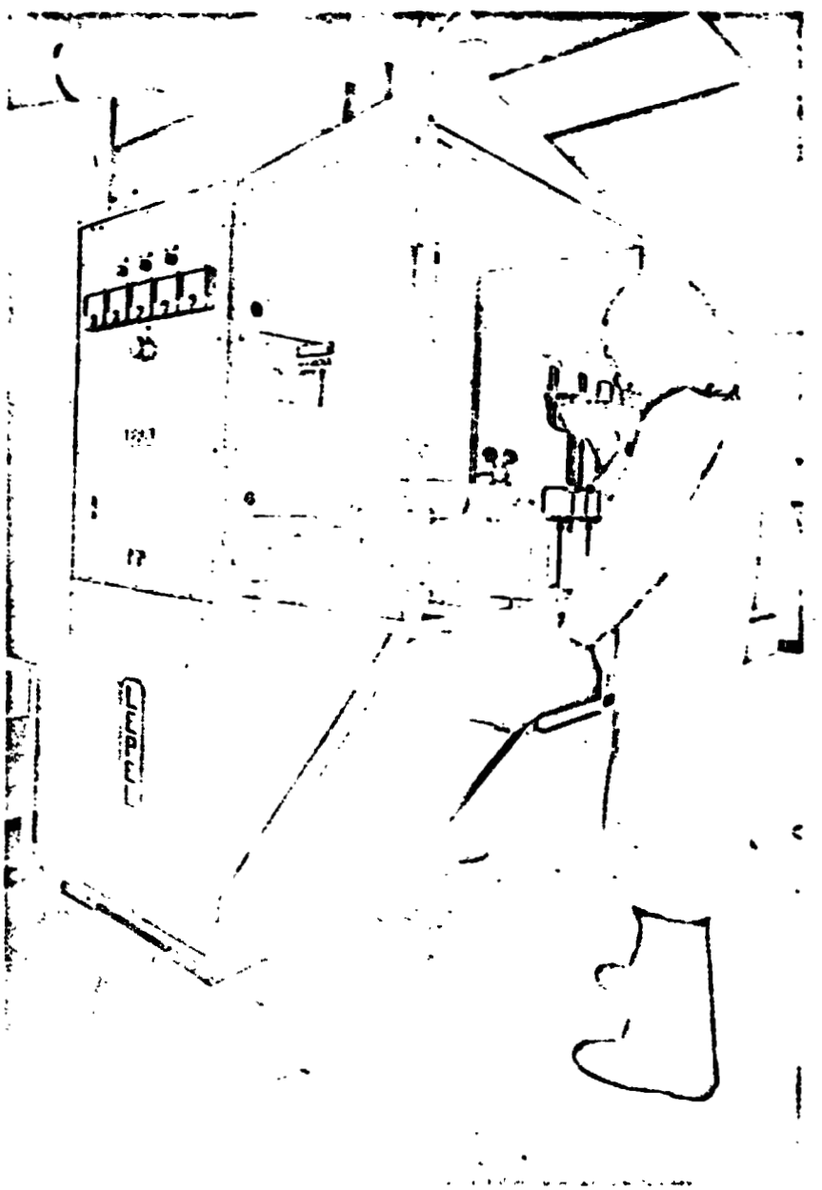
Comparison of Slit and Single-Edge LGT Deposition



Optical reflection + transmission for fast-deposition with a single-edge mask.



Equal Chromatic Order interference in infra-red transmission of an LGT film.



Chemical vapor deposition system for silicon.

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