

# University of Arkansas Microelectronics-Photonics Graduate Program

## PhD Candidacy Exam – March 2004

### Microelectronics Area of Emphasis Exam

#### PROBLEM TO BE SOLVED

You are the chief engineer of a company that produces a variety of consumer and aerospace microelectronics products. Naturally, diodes are performing a wide assortment of functions in many of your products. Your job is to study the possible use, in these applications in particular low power microwave devices, of resonant tunneling diodes based on any III-V MBE grown materials with multiple confined energy levels.

Your job is to evaluate the benefits and issues associated with integrating the resonant tunneling diodes in low power microwave devices. You should clearly (but briefly) explain what are the resonant tunneling diodes, how they work, and how they can be of benefit in your products. Also, you need to evaluate the required equipment, infrastructure and the resulting cost of implementing this technology.

#### YOUR DELIVERABLE

Your task is to write an internal proposal for your corporate officers describing your approach to this issue. Be sure you address all of the following:

**Current Technology** - What is already being done in this area by other researchers, companies and governmental institutions? The current state-of-the-art for both the science and the implementation should be described, making use of diverse resources such as science literature, journals, conference proceedings, the internet, patents or other sources of existing public knowledge. Be sure to cite all references used.

**Your Proposed Implementations** - Describe in detail how where you plan to use these devices and how they will benefit these applications. Include both the scientific/engineering basis and method of applying this to a workable solution.

**Manufacturing Flow** - Detail the step-by-step procedure for making these structures in a form useful in manufacturing.

**Testing and Qualification** - Describe a set of tests and demonstrations that you will use to demonstrate the effectiveness of your approach.

**Cost Analysis** - Perform a cost analysis that includes, at least, acquisition of raw materials, labor rates, costs per operation, etc. assuming quantities of 10,000 parts per year. You may exclude from your analysis possible additional costs in such infrastructure areas as human resources, facilities engineering, janitorial and grounds, upper level management, etc. You must include all direct manufacturing costs, both startup and continuing; and you must discuss explicitly space and personnel requirements to set up a stand-alone product line. Generic per process costs for various manufacturing methods can be used, as long as they are rationally applied.

**Intellectual Property** - List all IP sources that were consulted while formulating the answer, and include the full list of examined documents as an appendix to this exam. (The full list will not be counted as part of the 15-page limit.) From this list, identify the three that are the most significant threats to the IP you have created in your solution.