You are a senior development engineer for a major microelectronics manufacturer. One of your staff scientists has discovered a technique for plasma-depositing an electrically conductive polymer.

Material Characteristics:

resistivity = 30 - 400 mΩ-cm depending on deposition conditions
thermoplastic, melts at 140 - 250°C depending on deposition conditions
decomposes at 320°C
deposition rate: 2000 - 8000 Å/min depending on deposition conditions

The technique involves the use of two simultaneous plasma RF generators. The resulting "beat frequency" creates a highly unsaturated aromatic polymer compound which is electrically conductive.

Deposition Conditions

substrate temperature: room temperature to 130°C
pressure: 0.50 to 15 mTorr
input gas composition: 4 - 12% ethane in Ar

Section A: The vice-president of your division has asked you to evaluate this material and deposition technique as a methodology for flip-chip die attach. Your tasks are as follows:

1. Describe the flip-chip die attach processing flow you would use in sufficient detail to produce an equipment and materials funding budget request.
2. Design a testing regimen to evaluate the properties of this material for use as a flip-chip die attach material with regard to electrical conductivity, physical properties, ability to pass reliability testing and any other pertinent issues.
3. Compare the proposed method to traditional flip-chip methods with regard to cost per processed unit.
4. Provide a summary of relevant information for the patent lawyers to begin preparing a patent application. This should include the results of a patent search for similar technology already protected.

Section B: In the realm of making maximum use of newly developed technology, consider this second application of the material that we have been discussing. It is of interest to your company to use this electrically conductive polymer in an MCM-D as via fill for a 50 ohm transmission line carrying a 100 MHz signal frequency.

1. Discuss the applicability of this material for use as via fill material, concentrating specifically on the key customer interest in electrical signal transmission.
2. Describe the test structure you would use to determine if this material is a good candidate for via fill, given that the transmission lines are constructed of aluminum and the dielectric material between them is silicon dioxide of thickness 1 micron. Be sure to discuss all possible problems one might encounter in using this polymer as a via fill material.

Section C: Last, we would like you to propose another novel use of this material that you have become very familiar with in answering the first two parts of this examination. Your answer should be a management level discussion of the main points that would allow your management team to make the decision on whether to allow you to give them a detailed technical presentation on the subject next week.