# MATERIALS NEWS

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## TECHNICAL WRITING

MATERIALS NEWS readers are missing a lot of valuable information, perhaps yours! Why? Do you think you can't write or do you just have a hang-up in getting your thoughts down on paper. Well, don't let either stop you. There are many technical writers around the company who are more than willing to help you. After all, writing is their business. If you have information that you think would be of interest to MATERIALS NEWS readers, but would like help, contact myself or one of the fellows below (your Editorial Board). They'll hook you up with someone who can assist you.



For the rest of you, here are some guide lines to keep in mind when putting your thoughts down on paper.

1. Cover one subject at a time.
2. Keep it clear, avoid unusual terminology, or else define it.
3. State your thesis in the first paragraph.
4. Concentrate on purpose and a good summary. Leave out irrelevant details. Your reader can contact you for substantiating details.
5. Be sure your article is in a logical order.
6. MOST IMPORTANT — Write to your reader and keep it short.

Maybe like Marshall McLuhan prophesies, the written word will someday be replaced by a better medium. In the meantime, however, MATERIALS NEWS will have to fill the need for keeping us informed on materials. We hope you'll help us.

-Don Tucker, Ext 7976
Engineering Standards

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## MATERIALS STUDIES IN CRT DEVELOPMENT

At TEKTRONIX, our engineers are continually pushing the state of the art in the design of instruments, components and all other associated gear. This is even more true today than it has been in the past in the use of materials. Pertinent, unique materials are required. Furthermore, processes which preserve the material's uniqueness in a complete system or which provide for the adoption of materials to unique applications must be developed.

In looking for materials to meet TEK's specific sophisticated requirements, these inter-related approaches are considered:

1. Use available commerical sources.
2. Modify commercially available materials.
3. Develop proprietary materials.

Examples of these three approaches are given here. Materials which can be reliably purchased include devitrifying glasses for fritting, glass for faceplates, organic materials for potting, cathode materials such as barium carbonate, and nickel and stainless steel for gun parts.

In the category of materials needing modification are such things as carbon inks for PDA helix systems, modified for our particular use by the addition of binders and Baymal. Also, conductive frits for sealing feedthroughs to funnels are modified by changing the metallic content of the frit.

Among those proprietary materials developed from scratch are phosphors for display monitor tubes. Since no commercially available phosphor meets our sophisticated requirements, ways and means of generating a phosphor with the desired characteristics were investigated, resulting in production of TEK-made phosphors.

In this discussion, no attempt has been made to relate materials characteristics to processing techniques. The areas are, in fact, completely interdependent and in actual engineering, this point must be recognized in any materials utilization.

In summary, the most direct, inexpensive method is used which will provide materials meeting TEK's advanced requirements. There are no foreseeable reasons for changing this, and it is expected that TEK's look into the materials area will continue along these general lines for some time.

-Gordon Barnett, Ext 375
3D Manager

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## EPITAXY IN INTEGRATED CIRCUITS

The integrated circuit (IC) is playing an increasingly important role at TEKTRONIX. The demands of state-of-the-art electronics place a heavy burden on those involved with circuit and component development resulting in many problems which can only be solved by advanced IC technology. Such IC technology encompasses several important areas of materials science. Many will be reviewed here and in following reports.

The major portion of monolithic IC work depends upon the construction of discrete or interconnected electronic devices in semiconductor silicon. Growth of substrate silicon material is not pursued at TEK: however, epitaxial deposition of single crystal silicon forms much of the basis for our device construction. The precise control of such epitaxial depositions is one of the important processes in the eventual production of high quality integrated circuits.

Fabrication of our normal epitaxial monolithic IC's begins with a wafer of p-type silicon (boron doped). After a buried layer diffusion, an n-type layer of single crystal silicon is epitaxially deposited on the substrate material in the same crystallographic orientation as the host. This layer has opposite majority (charge) carriers and is phosphorous doped. The epi layer is conventionally 1-20 microns thick and this epi region can become the collector of a transistor or one of the elements of a diode. Process control at epi means the precise control of the thickness of the grown layer, the choice of dopant or impurity material, and the resultant resistivity of the layer.

At *TEK*, epitaxial silicon is grown using a silane process. This involves a simple, irreversible thermal decomposition of silane, or $SiH_4$. Such reaction forms free silicon which, at the high temperature of the reaction (approx. 1125°C), can be deposited on the surface of the substrate and eventually grow the thin epitaxial layer. The reaction is a simple pyrolysis:

$$SiH_4 \xrightarrow{\Delta} Si + 2H_2$$

By the control of the concentration of an injected impurity in the silane dope gas (phosphorous for n-type and boron for p-type) one can control the type and resistivity. One reaction product, hydrogen, actually acts to etch silicon at high temperatures but is such an insignificant effect that we usually mix silane with high-purity $H_2$ gas in the dope gas in an attempt to better control the results

The mechanical properties of the deposited layer form considerable interest to the materials engineer. One would like to be able to control and limit the presence of point imperfections, stacking faults, dislocations, and other lattice imperfections. Careful handling of substrate material prior to epitaxial depostion is extremely important. Contamination in very minute quantities can destroy the crystal order and such contamination can severely limit the resistivity of a growing layer. Carbon contamination, for example, can cause formation of silicon carbide specks in the epi that cannot be removed at a later time. Therefore, the quality of the epitaxial deposition is extremely dependent upon the general cleanliness of the system, the substrate material, and the gaseous sources used.

-Douglas Ritchie, Ext 7631
I.C. Engineering

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## *TEK* SERVICE GROUPS

### I. MATERIALS AND FASTENER APPLICATION GROUP OF ENGINEERING DEVELOPMENT SUPPORT

The Materials and Fastener Application Group is a service group devoted to Materials and Fastening Engineering.

The aim of the group is to:

1. Assist Engineering in the design and application of materials.
2. Assist and develop useful and economical joining techniques for materials, i.e., welding, ultrasonics, adhesives, etc.
3. To consult with and assist in experimental work for any area throughout *TEKTRONIX* needing help with materials, fastening and joining techniques.
4. To keep abreast of new materials and fastening techniques. We strive to keep other areas informed through educational seminars, group discussions and individual consultation.

If we can be of service, feel free to cal on us.

-Sil Arata, Ext 7287
Eng. Dev. Suprt

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## PROCESS CONTROL STUDY OF PLASTICS

The Plastics Department has undertaken the study of rheology in an effort to obtain a better understanding of the flow behaviors of polymer melts during the injection molding process. The instrument being used in the study simulates the environment of the barrel of the molding machine. In the barrel the solid plastic pellets are plasticized into a viscous polymer melt. The melt is then transferred to the mold by means of a moving ram.

The variables under investigation are temperature and shear rate (work applied to the melt). The readout consists of (1) the measurement of the changes in viscosity of a material under various operating conditions or (2) the measurement of the relative viscosity of different materials under similar operating conditions.

The information obtained from our laboratory instrument will assist in the following areas:

1. Selection of new materials for production.
2. Establishment of process conditions.
3. Examination of materials for lot-to-lot variation.

The current effort is being directed towards examination of presently used thermoplastic materials to provide a compilation of "standard" viscosity curves.

These curves will serve as a reference base from which the relative processability of new materials may be determined.

Future work will include investigation of such materials as mineral filled thermoplastics, thermosets, and plastisols.

-Dave Soine, Ext 6229
Plastic Process Engineering

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