This has been made possible by the development by Semiconductors, Ltd., of a symmetrical silicon alloy transistor to our specification. This is at present an experimental type, but is available in limited quantities.

It is hoped that it will be possible to publish a full account of this work in due course.

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ENGINEERING

A Systematic Method for the Construction of Error-correcting Group Codes

SLEPIAN[1] has pointed out that all systematic binary codes of length n form a sub-group of the group of all binary words of length n. The problem of choosing a systematic code for correcting a given set of errors is thus equivalent to finding a sub-group such that each error to be corrected for lies in separate cosets. Fire[2] has pointed out that the sum modulo 2 of two parity check sequences corresponding to two error patterns is the same as the parity check sequence corresponding to the sum modulo 2 of the same two error patterns. Also, each parity check sequence is uniquely associated with one coset. This sets up an isomorphism between the group of parity check sequences and the quotient group of the code group in the group of all words.

This consideration has led to a systematic method of generating group codes for correcting an arbitrary set of errors. The method has been applied to the generation of maximal two-error correcting codes of length 5–11, which coincides with the groups indicated by Slepian. The method is as follows : (1) Choose a set A of linearly independent error patterns which span the set of all 'allowable' error patterns, that is, error patterns to be corrected. (2) Choose two arbitrary parity check sequences to represent the first two of this set A of error patterns. Let us call this set of sequences B. (3) By modulo-two addition of members of B, generate the set of parity check sequences of all error patterns spanned by B. (4) Write down all parity check sequences so generated as well as the modulo-2 sums of those pairs of parity check sequences at least one of which forms an allowable error pattern by addition-modulo two with the next member of A. (5) Choose a parity check sequence outside the set generated in step (4) to represent the next error pattern in A and append this to the set B. (6) Repeat steps (3), (4) and (5) until all possible error patterns have been spanned.

In the case of the two-error correcting code mentioned earlier, the set A may be conveniently chosen as the set of all single errors, and the initial two parity check sequences can be conveniently chosen as the binary 1 and 2, that is, 000 . . . 01 and 000 . . . 10.

In this case step (4) simply reads : (4), Write down all parity check sequences of double errors generated by the single errors in B as well as the sum modulo 2 of pairs of these parity check sequences at least one of which is a single error parity check sequence. It may be interesting to record that the time taken to generate all two-error correcting codes of 5–11 bits long was 4 hr. by hand.

I am at present setting up a computer programme to generate the parity check sequences for longer blocks of binary digits. After getting the parity check sequences, it is a simple matter to generate the group codes and parity check rules.

I expect to publish the results of the computer data with a more detailed description of the method and its theoretical basis elsewhere.

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[1] Slepian, D., *Bell Syst. Tech. J.*, **35**, 203 (1956).

[2] Fire, P., Technical Report No. 55, Stanford Electronics Laboratories, Stanford University (April 24, 1959).

MINERALOGY

Predehydroxylation State of Kaolinite

THE loss of water of constitution from kaolinite with increasing temperature under atmospheric pressure is illustrated in Fig. 1. This loss is very low, up to about 450° C., where it increases very rapidly. The infra-red spectrum of an unheated sample shows a hydroxyl vibration band about equally divided into three transmission minima the frequencies of which are located respectively at 3,700 cm.$^{-1}$, 3,663 cm.$^{-1}$ and 3,627 cm.$^{-1}$.

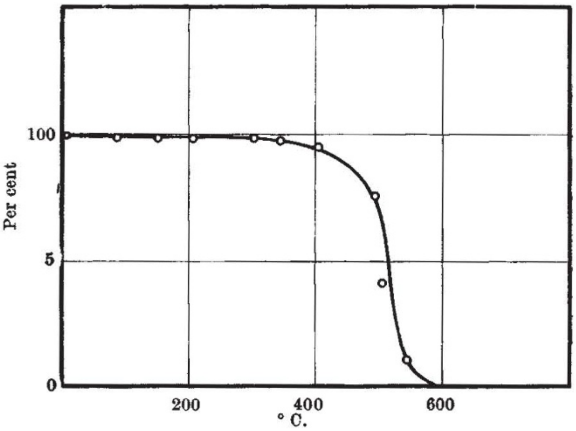

Fig. 1. Relative water content of kaolinite as a function of the temperature under atmospheric pressure

The last one is slightly larger than the other two, the differences being, however, rather small : relative absorbances are 0·91 : 0·92 : 1. When a clay film is heated, the infra-red spectrum undergoes several modifications : the resolution into three components disappears progressively with increasing temperature and, above 400° C., a band only may be observed at about 3,680 cm.$^{-1}$. Beyond this point, relative intensities remain unchanged and, after cooling, the initial shape of the band is restored. Fig. 2 shows the hydroxyl bands observed during a heating and cooling cycle. The process is thus obviously reversible. Fig. 3 gives the changes in frequencies.

One may conclude that, before dehydroxylation starts, kaolinite is modified and brought into a new structural state characterized by the fact that the three initial minima of the hydroxyl vibration band are 'fused' into a single transmission minimum.

As soon as this structural state obtains, dehydroxylation may start, but there is no longer a perfect