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(21) International Application Number: PCT/US92/05198 (22) International Filing Date: 18 June 1992 (18.06.92) (30) Priority data: 717,436 19 June 1991 (19.06.91) US 802,938 6 December 1991 (06.12.91) US (71) Applicant: MOBIL OIL CORPORATION [US/US]; 3225 Gallows Road, Fairfax, VA 22037 (US). (72) Inventors: BENNETT, John, Michael ; 661 Weadley Road, Radnor, PA 19087 (US). CHANG, Clarence, Dayton ; 11 Murray Place, Princeton, NJ 08540 (US). LAWTON, Stephen, Latham ; 620 Howard Avenue, Pitman, NJ 03071 (US). LEONOWICZ, Michael, Edward ; 201 Migazee Trail, Medford Lakes, NJ 08055 (US). LISSY, Daria, Nowakiwska ; 404 South Ivy Lane, Glen Mills, PA 19342 (US). RUBIN, Mae, Koenig ; 50 Belmont Avenue, Bala Cynwyd, PA 19004 (US).	(74) Agents: ROBERTS, Peter, W. et al.; Mobil Oil Corporation, 3225 Gallows Road, Fairfax, VA 22037 (US). (81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, KR, LU (European patent), MC (European patent), NL (European patent), SE (European patent). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>																																	
(54) Title: SYNTHETIC CRYSTALLINE ZEOLITE, ITS SYNTHESIS AND USE																																		
<p>TABLE (I)</p> <p><u>Interplanar d-Spacing (A)</u> <u>Relative Intensity, I/I₀ x 100</u></p> <table style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td style="text-align: center;">13.15</td> <td style="text-align: center;">±</td> <td style="text-align: center;">0.26</td> <td style="text-align: center;">w-s *</td> </tr> <tr> <td style="text-align: center;">12.49</td> <td style="text-align: center;">±</td> <td style="text-align: center;">0.24</td> <td style="text-align: center;">vs</td> </tr> <tr> <td style="text-align: center;">11.19</td> <td style="text-align: center;">±</td> <td style="text-align: center;">0.22</td> <td style="text-align: center;">m-s</td> </tr> <tr> <td style="text-align: center;">6.43</td> <td style="text-align: center;">±</td> <td style="text-align: center;">0.12</td> <td style="text-align: center;">w</td> </tr> <tr> <td style="text-align: center;">4.98</td> <td style="text-align: center;">±</td> <td style="text-align: center;">0.10</td> <td style="text-align: center;">w</td> </tr> <tr> <td style="text-align: center;">4.69</td> <td style="text-align: center;">±</td> <td style="text-align: center;">0.09</td> <td style="text-align: center;">w</td> </tr> <tr> <td style="text-align: center;">3.44</td> <td style="text-align: center;">±</td> <td style="text-align: center;">0.07</td> <td style="text-align: center;">vs</td> </tr> <tr> <td style="text-align: center;">3.24</td> <td style="text-align: center;">±</td> <td style="text-align: center;">0.06</td> <td style="text-align: center;">w</td> </tr> </tbody> </table> <p>* shoulder.</p>			13.15	±	0.26	w-s *	12.49	±	0.24	vs	11.19	±	0.22	m-s	6.43	±	0.12	w	4.98	±	0.10	w	4.69	±	0.09	w	3.44	±	0.07	vs	3.24	±	0.06	w
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(57) Abstract A synthetic crystalline zeolite, MCM-49, has in its as-synthesized form an X-ray diffraction pattern including values substantially as set forth in Table (I).																																		

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**SYNTHETIC CRYSTALLINE ZEOLITE,
ITS SYNTHESIS AND USE**

This invention relates to a synthetic crystalline zeolite, to a method for its synthesis and to its use in catalytic conversion of organic compounds.

Zeolitic materials, both natural and synthetic, have been demonstrated in the past to have catalytic properties for various types of hydrocarbon conversion. Certain zeolitic materials are ordered, porous crystalline aluminosilicates having a definite crystalline structure as determined by X-ray diffraction, within which there are a large number of smaller cavities which may be interconnected by a number of still smaller channels or pores. These cavities and pores are uniform in size within a specific zeolitic material. Since the dimensions of these pores are such as to accept for adsorption molecules of certain dimensions while rejecting those of larger dimensions, these materials have come to be known as "molecular sieves" and are utilized in a variety of ways to take advantage of these properties.

Such molecular sieves, both natural and synthetic, include a wide variety of positive ion-containing crystalline silicates. These silicates can be described as a rigid three-dimensional framework of SiO_4 and Periodic Table Group IIIA element oxide, e.g. AlO_4 , in which the tetrahedra are cross-linked by the sharing of oxygen atoms whereby the ratio of the total Group IIIA element, e.g. aluminum, and silicon atoms to oxygen atoms is 1:2. The electrovalence of the tetrahedra containing the Group IIIA element, e.g. aluminum, is balanced by the inclusion in the crystal of a cation, for example an alkali metal or an alkaline earth metal cation. This can be expressed wherein the ratio of the Group IIIA element, e.g. aluminum, to the number of various cations, such as $\text{Ca}/2$, $\text{Sr}/2$, Na, K or

Li, is equal to unity. One type of cation may be exchanged either entirely or partially with another type of cation utilizing ion exchange techniques in a conventional manner. By means of such cation exchange, it has been possible to vary the properties of a given silicate by suitable selection of the cation. The spaces between the tetrahedra are occupied by molecules of water prior to dehydration.

Prior art techniques have resulted in the formation of a great variety of synthetic zeolites. Many of these zeolites have come to be designated by letter or other convenient symbols, as illustrated by zeolite A (U.S. Patent 2,882,243); zeolite X (U.S. Patent 2,882,244); zeolite Y (U.S. Patent 3,130,007); zeolite ZK-5 (U.S. Patent 3,247,195); zeolite ZK-4 (U.S. Patent 3,314,752); zeolite ZSM-5 (U.S. Patent 3,702,886); zeolite ZSM-11 (U.S. Patent 3,709,979); zeolite ZSM-12 (U.S. Patent 3,832,449), zeolite ZSM-20 (U.S. Patent 3,972,983); ZSM-35 (U.S. Patent 4,016,245); zeolite ZSM-23 (U.S. Patent 4,076,842); zeolite MCM-22 (U.S. Patent 4,954,325); and zeolite MCM-35 (U.S. Patent 4,981,663).

U.S. Patent 4,439,409 refers to a zeolite named PSH-3 and its synthesis from a reaction mixture containing hexamethyleneimine. Hexamethyleneimine is also used for synthesis of zeolite MCM-22 in U.S. Patent 4,954,325; zeolite MCM-35 in U.S. Patent 4,981,663; and zeolite ZSM-12 in U.S. Patent 5,021,141.

The present invention is directed to a synthetic crystalline zeolite, referred to herein as MCM-49, which is structurally related to, but different from, MCM-22.

Accordingly, the invention resides in a synthetic crystalline zeolite having, in its as-synthesized form, an X-ray diffraction pattern including values substantially as set forth in Table I below.

The invention will now be more particularly described with reference to the accompanying drawings, in which

5 Figure 1a shows a segment of the X-ray diffraction pattern of the as-synthesized precursor of MCM-22 from a repeat of Example 1 of U.S. Patent 4,954,325,

Figure 1b shows a segment of the X-ray diffraction pattern of the as-synthesized crystalline material product of Example 7 of the present invention,

10 Figure 1c shows a segment of the X-ray diffraction pattern of the calcined MCM-22 from a repeat of Example 1 of U.S. Patent 4,954,325,

Figures 2-7 are X-ray diffraction patterns of the as-synthesized crystalline material products of the present Examples 1, 3, 5, 7, 8, and 11, respectively, and,

Figure 8 compares the ²⁷AR MAS NMR spectra of calcined MCM-22 and calcined MCM-49.

20 The zeolite of the present invention, MCM-49, is characterized in its as-synthesized form by an X-ray diffraction pattern including the lines listed in Table 1 below:

TABLE I

Interplanar d-Spacing (A) Relative Intensity, I/I₀ x 100

25	13.15 ± 0.26	w-s*
	12.49 ± 0.24	vs
	11.19 ± 0.22	m-s
	6.43 ± 0.12	w
	4.98 ± 0.10	w
30	4.69 ± 0.09	w
	3.44 ± 0.07	vs
	3.24 ± 0.06	w

* shoulder.

35 The X-ray diffraction peak at 13.15 ± 0.26 Angstrom Units (A) is usually not fully resolved for MCM-49 from the intense peak at 12.49 ± 0.24, and is observed as a shoulder of this intense peak. For this reason, the precise intensity and position of the 13.15

± 0.26 Angstroms peak are difficult to determine within the stated range.

On calcination, the crystalline MCM-49 material of the invention transforms to a single crystal phase with little or no detectable impurity crystal phases having an X-ray diffraction pattern which is not readily distinguished from that of MCM-22 described in U.S. Patent 4,954,325, but is distinguishable from the patterns of other known crystalline materials. The X-ray diffraction pattern of the calcined form of MCM-49 includes the lines listed in Table II below:

TABLE II

Interplanar d-Spacing (A) Relative Intensity, I/I₀ x 100

	12.41	±	0.24	vs
15	11.10	±	0.22	s
	8.89	±	0.17	m-s
	6.89	±	0.13	w
	6.19	±	0.12	m
	6.01	±	0.12	w
20	5.56	±	0.11	w
	4.96	±	0.10	w
	4.67	±	0.09	w
	4.59	±	0.09	w
	4.39	±	0.09	w
25	4.12	±	0.08	w
	4.07	±	0.08	w-m
	3.92	±	0.08	w-m
	3.75	±	0.07	w-m
	3.57	±	0.07	w
30	3.43	±	0.07	s-vs
	3.31	±	0.06	w
	3.21	±	0.06	w
	3.12	±	0.06	w
	3.07	±	0.06	w
35	2.83	±	0.05	w
	2.78	±	0.05	w
	2.69	±	0.05	w
	2.47	±	0.05	w
	2.42	±	0.05	w
40	2.38	±	0.05	w

These X-ray diffraction data were collected with a Scintag diffraction system, equipped with a germanium solid state detector, using copper K-alpha radiation. The diffraction data were recorded by step-scanning at 0.02 degrees of two-theta, where theta is the Bragg angle, and a counting time of 10 seconds for each step. The interplanar spacings, d's, were calculated in Angstrom units (A), and the relative intensities of the lines, I/I_0 is one-hundredth of the intensity of the strongest line, above background, were derived with the use of a profile fitting routine (or second derivative algorithm). The intensities are uncorrected for Lorentz and polarization effects. The relative intensities are given in terms of the symbols vs = very strong (60-100), s = strong (40-60), m = medium (20-40) and w = weak (0-20).

The significance of the differences in the X-ray diffraction patterns of as-synthesized and calcined materials can be explained from a knowledge of the structures of the related materials MCM-22 and PSH-3. Thus MCM-22 and PSH-3 are members of an unusual family of materials because, upon calcination, there are changes in the X-ray diffraction pattern that can be explained by a significant change in one axial dimension. This is indicative of a profound change in the bonding within the materials and not a simple loss of the organic material. The precursor members of this family can be clearly distinguished by X-ray diffraction from the calcined members. An examination of the X-ray diffraction patterns of both precursor and calcined forms shows a number of reflections with very similar position and intensity, while other peaks are different. Some of these differences are directly related to the changes in the axial dimension and bonding.

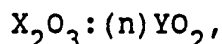
The present as-synthesized MCM-49 has an axial dimension similar to those of the calcined members of

the family and, hence, there are similarities in their X-ray diffraction patterns. Nevertheless, the MCM-49 axial dimension is different from that observed in the calcined materials. For example, the changes in axial dimensions in MCM-22 can be determined from the positions of peaks particularly sensitive to these changes. Two such peaks occur at ~ 13.5 Angstroms and ~ 6.75 Angstroms in precursor MCM-22, at ~ 12.8 Angstroms and ~ 6.4 Angstroms in as-synthesized MCM-49, and at ~ 12.6 Angstroms and ~ 6.30 Angstroms in calcined MCM-22. Unfortunately, the ~ 12.8 Angstroms peak in MCM-49 is very close to the intense ~ 12.4 Angstroms peak observed for all three materials, and is frequently not fully separated from it. Likewise, the ~ 12.6 Angstroms peak of the calcined MCM-22 material is usually only visible as a shoulder on the intense ~ 12.4 Angstroms peak. Figure 1 shows the same segment of the diffraction patterns of precursor MCM-22, calcined MCM-22, and MCM-49; the position of the ~ 6.6-6.3 Angstroms peak is indicated in each segment by an asterisk. Because the ~ 6.4 Angstroms peak is unobscured in MCM-49, it was chosen as a better means of distinguishing MCM-49 from the calcined forms of MCM-22 and PSH-3 rather than the much stronger ~ 12.8 Angstroms peak.

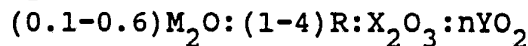
As shown in Figure 8, a difference between calcined MCM-49 and calcined MCM-22 can be demonstrated by ^{27}Al MAS NMR. When calcined completely to remove the organic material used to direct its synthesis, (Figure 8D) MCM-49 exhibits a ^{27}Al MAS NMR spectrum different from that of fully calcined MCM-22 (Figure 8A). In each case, calcination is effected at 538°C for 16 hours. The NMR spectra are obtained using a Bruker MSL-400 spectrometer at 104.25 MHz with 5.00 KHz spinning speed, 1.0 μs excitation pulses (solution $\pi/2 = 6\mu\text{s}$), and 0.1S recycle times. The number of transients obtained for each sample is 2000 and the

²⁷Al chemical shifts are referenced to a 1M aqueous solution of Al(NO₃)₂ at 0.0 ppm. As shown in Figures 8B and 8C, fully calcined MCM-22 exhibits a ²⁷Al MAS NMR spectrum in which the T_d AL region can be simulated as comprising 3 peaks centered at 61, 55 and 50 ppm having approximate relative areas of 10:50:40. In contrast, fully calcined MDM-49 exhibits a ²⁷Al MAS NMR spectrum in which the T_d Al region can be simulated as comprising the 3 peaks center at 61, 55, and 50 ppm but having approximate relative areas of 20:45:35, together with a fourth broad peak centered at 54 ppm (Figures 8E and 8F). Formation of the broad T_d component does not appear to be dependent on the calcination environment (air or nitrogen). Calcined MCM-49 also exhibits distinctly different catalytic properties than calcined MCM-22.

The crystalline material of this invention has a composition comprising the molar relationship:



wherein X is a trivalent element, such as aluminum, boron, iron and/or gallium, preferably aluminum; Y is a tetravalent element such as silicon and/or germanium, preferably silicon; and n is less than 35, preferably from 11 to less than 20, most preferably from 15 to less than 20. More specifically, the crystalline material of this invention has a formula, on an anhydrous basis and in terms of moles of oxides per n moles of YO₂, as follows:



wherein M is an alkali or alkaline earth metal, and R is an organic directing agent. The M and R components are associated with the material as a result of their presence during crystallization, and are easily removed by post-crystallization methods hereinafter more particularly described.

The crystalline material of the invention is thermally stable and in the calcined form exhibits high

surface area (greater than $400 \text{ m}^2/\text{gm}$) and an Equilibrium Adsorption capacity of greater than 10 wt.% for water vapor, greater than 4.3 wt.%, usually greater than 7 wt.%, for cyclohexane vapor and greater than 10 wt.% for n-hexane vapor.

The present crystalline material can be prepared from a reaction mixture containing sources of alkali or alkaline earth metal (M), e.g. sodium or potassium, cation, an oxide of trivalent element X, e.g. aluminum, an oxide of tetravalent element Y, e.g. silicon, organic directing agent (R), and water, said reaction mixture having a composition, in terms of mole ratios of oxides, within the following ranges:

<u>Reactants</u>	<u>Broad</u>	<u>Preferred</u>
$\text{YO}_2/\text{X}_2\text{O}_3$	12 to <35	15 to 25
$\text{H}_2\text{O}/\text{YO}_2$	10 to 70	15 to 40
OH^-/YO_2	0.05 to 0.50	0.05 to 0.30
M/YO_2	0.05 to 3.0	0.05 to 1.0
R/YO_2	0.2 to 1.0	0.3 to 0.5

In the present synthesis method, the source of YO_2 should predominately be solid YO_2 , for example at least about 30 wt.% solid YO_2 , in order to obtain the crystal product of the invention. Where YO_2 is silica, the use of a silica source containing at least about 30 wt.% solid silica, e.g. Ultrasil (a precipitated, spray dried silica containing about 90 wt.% silica) or HiSil (a precipitated hydrated SiO_2 containing about 87 wt.% silica, about 6 wt.% free H_2O and about 4.5 wt.% bound H_2O of hydration and having a particle size of about 0.02 micron) favors crystalline MCM-49 formation from the above mixture. Preferably, therefore, the YO_2 , e.g. silica, source contains at least about 30 wt.% solid YO_2 , e.g. silica, and more preferably at least about 40 wt.% solid YO_2 , e.g. silica.

The directing agent R is selected from the group consisting of cycloalkylamine, azacycloalkane, diazacycloalkane, and mixtures thereof, alkyl

comprising from 5 to 8 carbon atoms. Non-limiting examples of R include cyclopentylamine, cyclohexylamine, cycloheptylamine, hexamethyleneimine, heptamethyleneimine, homopiperazine, and combinations thereof. However, in the case of hexamethyleneimine, it is found that pure MCM-49 can only be produced within the narrow silica/alumina range of 15 to less than 20, since above this range the product contains at least some MCM-22. Thus when R is hexamethyleneimine, the YO_2/X_2O_3 range in the reaction mixture composition tabulated above should be 15 to 25.

The R/M ratio is also important in the synthesis of MCM-49 in preference to other crystalline phases, such as MCM-22, since it is found that MCM-49 is favored when the R/M ratio is less than 3 and preferably is less than 1.

Crystallization of the present crystalline material can be carried out at either static or stirred conditions in a suitable reactor vessel, such as for example, polypropylene jars or teflon lined or stainless steel autoclaves. Crystallization is generally performed at a temperature of 80°C to 225°C for a time of 24 hours to 60 days. Thereafter, the crystals are separated from the mother liquid and recovered.

It should be realized that the reaction mixture components can be supplied by more than one source. The reaction mixture can be prepared either batchwise or continuously. Crystal size and crystallization time of the new crystalline material will vary with the nature of the reaction mixture employed and the crystallization conditions.

Synthesis of the new crystals may be facilitated by the presence of at least 0.01 percent, preferably 0.10 percent and still more preferably 1 percent, seed crystals (based on total weight) of crystalline

product. Useful seed crystals include MCM-22 and/or MCM-49.

To the extent desired, the original sodium cations of the as-synthesized material can be replaced in accordance with techniques well known in the art, at least in part, by ion exchange with other cations. Preferred replacing cations include metal ions, hydrogen ions, hydrogen precursor, e.g. ammonium, ions and mixtures thereof. Particularly preferred cations are those which tailor the catalytic activity for certain hydrocarbon conversion reactions. These include hydrogen, rare earth metals and metals of Groups IIA, IIIA, IVA, IB, IIB, IIIB, IVB and VIII of the Periodic Table of the Elements.

When used as a catalyst, the crystalline material of the invention may be subjected to treatment to remove part or all of any organic constituent. Typically this treatment involves heating at a temperature of 370 to 925°C for at least 1 minute and generally not longer than 20 hours. The crystalline material can also be used as a catalyst in intimate combination with a hydrogenating component such as tungsten, vanadium, molybdenum, rhenium, nickel, cobalt, chromium, manganese, or a noble metal such as platinum or palladium where a hydrogenation-dehydrogenation function is to be performed. Such component can be in the composition by way of cocrystallization, exchanged into the composition to the extent a Group IIIA element, e.g. aluminum, is in the structure, impregnated therein or intimately physically admixed therewith. Such component can be impregnated in or on to it such as, for example, by, in the case of platinum, treating the silicate with a solution containing a platinum metal-containing ion. Thus, suitable platinum compounds for this purpose include chloroplatinic acid, platinous

chloride and various compounds containing the platinum amine complex.

The crystalline material of this invention can be used to catalyze a wide variety of chemical conversion processes including many of present commercial/industrial importance. Examples of chemical conversion processes which are effectively catalyzed by the crystalline material of this invention, by itself or in combination with one or more other catalytically active substances including other crystalline catalysts, include those requiring a catalyst with acid activity. Specific examples include:

(1) alkylation of aromatic hydrocarbons, e.g. benzene, with long chain olefins, e.g. C₁₄ olefin, with reaction conditions including a temperature of 340°C to 500°C, a pressure of 100 to 20000 kPa (1 to 200 atmospheres), a weight hourly space velocity of 2 hr⁻¹ to 2000 hr⁻¹ and an aromatic hydrocarbon/olefin mole ratio of 1/1 to 20/1, to provide long chain alkyl aromatics which can be subsequently sulfonated to provide synthetic detergents;

(2) alkylation of aromatic hydrocarbons with gaseous olefins to provide short chain alkyl aromatic compounds, e.g. the alkylation of benzene with propylene to provide cumene, with reaction conditions including a temperature of 10°C to 125°C, a pressure of 100 to 3000 kPa (1 to 30 atmospheres), and an aromatic hydrocarbon weight hourly space velocity (WHSV) of from 5 hr⁻¹ to 50 hr⁻¹;

(3) alkylation of reformate containing substantial quantities of benzene and toluene with fuel gas containing C₅ olefins to provide, inter alia, mono- and dialkylates with reaction conditions including a temperature of 315°C to 455°C, a pressure of 2850 to 5600 kPa (400 to 800 psig), a

WHSV-olefin of 0.4 hr^{-1} to 0.8 hr^{-1} , a WHSV-reformate of 1 hr^{-1} to 2 hr^{-1} and a gas recycle of 1.5 to 2.5 vol/vol fuel gas feed;

- 5 (4) alkylation of aromatic hydrocarbons, e.g. benzene, toluene, xylene and naphthalene, with long chain olefins, e.g. C_{14} olefin, to provide alkylated aromatic lube base stocks with reaction conditions including a temperature of 160°C to 260°C and a pressure of 2500 to 3200 kPa (350 to 10 450 psig); and
- (5) alkylation of phenols with olefins or equivalent alcohols to provide long chain alkyl phenols with reaction conditions including a 15 temperature of 200°C to 250°C , a pressure of 1480 to 2170 kPa (200 to 300 psig) and a total WHSV of 2 hr^{-1} to 10 hr^{-1} .

When used as a catalyst, it may be desirable to incorporate the composition of the invention with another material resistant to the temperatures and 20 other conditions employed in organic conversion processes. Such materials include active and inactive materials and synthetic or naturally occurring zeolites as well as inorganic materials such as clays, silica and/or metal oxides such as alumina. The latter may be 25 either naturally occurring or in the form of gelatinous precipitates or gels including mixtures of silica and metal oxides. Use of a material in conjunction with the new crystal, i.e. combined therewith or present during synthesis of the new crystal, which is active, 30 tends to change the conversion and/or selectivity of the catalyst in certain organic conversion processes. Inactive materials suitably serve as diluents to control the amount of conversion in a given process so that products can be obtained economically and orderly 35 without employing other means for controlling the rate of reaction. These materials may be incorporated into naturally occurring clays, e.g. bentonite and kaolin,

to improve the crush strength of the catalyst under commercial operating conditions. Said materials, i.e. clays, oxides, etc., function as binders for the catalyst. It is desirable to provide a catalyst having good crush strength because in commercial use it is desirable to prevent the catalyst from breaking down into powder-like materials. These clay and/or oxide binders have been employed normally only for the purpose of improving the crush strength of the catalyst.

Naturally occurring clays which can be composited with the new crystal include the montmorillonite and kaolin family, which families include the subbentonites, and the kaolins commonly known as Dixie, McNamee, Georgia and Florida clays or others in which the main mineral constituent is halloysite, kaolinite, dickite, nacrite, or anauxite. Such clays can be used in the raw state as originally mined or initially subjected to calcination, acid treatment or chemical modification. Binders useful for compositing with the present crystal also include inorganic oxides, notably alumina.

In addition to the foregoing materials, the new crystal can be composited with a porous matrix material such as silica-alumina, silica-magnesia, silica-zirconia, silica-thoria, silica-beryllia, silica-titania as well as ternary compositions such as silica-alumina-thoria, silica-alumina-zirconia, silica-silica-alumina-magnesia and silica-magnesia-zirconia.

The relative proportions of finely divided crystalline material and inorganic oxide matrix vary widely, with the crystal content ranging from 1 to 90 percent by weight and more usually, particularly when the composite is prepared in the form of beads, in the range of 2 to 80 weight percent of the composite.

The invention will now be more particularly described with reference to the following examples.

In the examples, whenever sorption data are set forth for comparison of sorptive capacities for water, cyclohexane and/or n-hexane, they were Equilibrium Adsorption values determined as follows:

5 A weighed sample of the calcined adsorbant was contacted with the desired pure adsorbate vapor in an adsorption chamber, evacuated to less than 133 kPa (1 mmHg) and contacted with 1.6 kPa (12 Torr) of water vapor and 5.3 kPa (40 Torr) of n-hexane or cyclohexane
10 vapor, pressures less than the vapor-liquid equilibrium pressure of the respective adsorbate at 90°C. The pressure was kept constant (within about ± 0.5 mm) by addition of adsorbate vapor controlled by a manostat during the adsorption period, which did not exceed
15 about 8 hours. As adsorbate was adsorbed by the test sample, the decrease in pressure caused the manostat to open a valve which admitted more adsorbate vapor to the chamber to restore the above control pressures. Sorption was complete when the pressure change was not
20 sufficient to activate the manostat. The increase in weight was calculated as the adsorption capacity of the sample in g/100 g of calcined adsorbant.

 When Alpha Value is examined, it is noted that the Alpha Value is an approximate indication of the
25 catalytic cracking activity of the catalyst compared to a standard catalyst and it gives the relative rate constant (rate of normal hexane conversion per volume of catalyst per unit time). It is based on the activity of silica-alumina cracking catalyst taken as
30 an Alpha of 1 (Rate Constant = 0.016 sec^{-1}). The Alpha Test is described in U.S. Patent 3,354,078; in the Journal of Catalysis, Vol. 4, p. 527 (1965); Vol. 6, p. 278 (1966); and Vol. 61, p. 395 (1980). The experimental conditions of the test used herein include
35 a constant temperature of 538°C and a variable flow rate as described in detail in the Journal of Catalysis, Vol. 61, p. 395.

EXAMPLE 1

A 1 part quantity of $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$ was dissolved in a solution containing 1.83 parts of 50% NaOH solution and 13 parts of H_2O . To this were added
 5 1.78 parts of hexamethyleneimine (HMI) followed by 6.6 parts of amorphous silica precursor (46% solids). The mixture was thoroughly mixed until uniform.

The reaction mixture had the following composition in mole ratios:

10	$\text{SiO}_2/\text{Al}_2\text{O}_3$	=	30
	OH^-/SiO_2	=	0.25
	Na/SiO_2	=	0.43
	HMI/SiO_2	=	0.35
	$\text{H}_2\text{O}/\text{SiO}_2$	=	19.4

15 The mixture was crystallized in a stirred reactor at 150°C for 4 days. The crystals were filtered, washed with water and dried at 120°C . A portion of the product was submitted for X-ray analysis and identified as the new crystalline material MCM-49. The material
 20 exhibited the X-ray powder diffraction pattern as shown in Table III and Figure 2.

The chemical composition of the product was, in wt. %:

	N	1.81
25	Na	0.38
	Al_2O_3	7.1
	SiO_2	72.8
	Ash	79.2

The $\text{SiO}_2/\text{Al}_2\text{O}_3$ molar ratio of this product was 17.4.

30 The sorption capacities, after calcining for 6 hours at 538°C were, in wt. %:

	Cyclohexane, 40 Torr	4.4
	n-Hexane, 40 Torr	12.8
	H_2O , 12 Torr	11.1

35 A portion of the sample was calcined in air for 16 hours at 538°C . This material exhibited the X-ray diffraction pattern shown in Table IV.

TABLE III

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I_o</u>
	3.2	27.5	11
5	6.75	13.09	36 sh
	7.08	12.49	100
	7.88	11.23	40
	9.81	9.02	24
	12.79	6.92	13
10	13.42	6.60	5*
	13.87	6.38	6
	14.24	6.22	7
	14.64	6.05	4
	15.24	5.81	2
15	15.81	5.61	8
	17.72	5.01	2
	18.91	4.69	4
	19.27	4.61	5
	20.09	4.42	19
20	20.83	4.26	6
	21.48	4.14	15
	21.78	4.08	29
	22.22	4.00	12
	22.59	3.94	36
25	23.56	3.78	19
	24.87	3.58	21
	25.10	3.55	6
	25.89	3.44	80
	26.32	3.39	7
30	26.81	3.33	17
	27.57	3.24	11
	28.36	3.15	7
	29.03	3.08	3
	29.50	3.03	2
35	31.47	2.842	3
	32.16	2.784	3
	33.26	2.694	6
	34.08	2.631	2
	34.83	2.576	1
40	36.25	2.478	2
	36.96	2.432	2
	37.72	2.385	7

 sh = Shoulder

* = Impurity peak

TABLE IV

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I_o</u>
	3.4	26.0	6
5	6.96	12.69	45 sh
	7.15	12.37	100
	7.97	11.09	58
	9.97	8.87	49
	12.88	6.88	10
10	13.50	6.56	3*
	14.34	6.18	26
	14.76	6.00	8
	15.30	5.79	1
	15.96	5.55	13
15	17.84	4.97	1
	19.03	4.66	3
	19.34	4.59	2
	19.67	4.51	2*
	20.26	4.38	10
20	21.18	4.20	3
	21.59	4.12	10
	21.88	4.06	17
	22.40	3.97	8
	22.72	3.91	28
25	23.74	3.75	16
	24.73	3.60	3
	24.98	3.57	10
	25.23	3.53	5
	26.00	3.43	57
30	26.98	3.30	12
	27.81	3.21	12
	28.64	3.12	7
	29.14	3.06	2
	29.69	3.01	2
35	31.62	2.830	3
	32.28	2.773	3
	33.38	2.685	6
	34.43	2.605	2
	34.98	2.565	2
40	36.39	2.469	1
	37.09	2.424	2
	37.86	2.377	4

sh = Shoulder

45 * = Impurity peak

EXAMPLE 2

The calcined portion of the product of Example 1 was ammonium exchanged and calcined at 538°C in air for 16 hours to provide the hydrogen form transformation product of the crystalline MCM-49. The Alpha Test proved this material to have an Alpha Value of 291.

EXAMPLE 3

A 1.45 part quantity of sodium aluminate was added to a solution containing 1 part of 50% NaOH solution and 53.1 parts H₂O. A 5.4 part quantity of HMI was added, followed by 10.3 parts of Ultrasil, a precipitated spray-dried silica (about 90% SiO₂). The reaction mixture was thoroughly mixed and transferred to a stainless steel autoclave equipped with a stirrer.

The reaction mixture had the following composition in mole ratios:

SiO ₂ /Al ₂ O ₃	=	25
OH ⁻ /SiO ₂	=	0.19
Na/SiO ₂	=	0.19
HMI/SiO ₂	=	0.35
H ₂ O/SiO ₂	=	19.3

The mixture was crystallized with stirring at 150°C for 8 days. The product was identified as poorly crystalline MCM-49 and had the X-ray pattern which appears in Table V and Figure 3.

The chemical composition of the product was, in wt. %:

N	2.29
Na	0.19
Al ₂ O ₃	6.3
SiO ₂	71.0
Ash	77.9

The silica/alumina mole ratio of the product was 19.2.

The sorption capacities, after calcining for 16 hours at 538°C were, in wt. %:

	Cyclohexane, 40 Torr	9.9
	n-Hexane, 40 Torr	14.6
5	H ₂ O, 12 Torr	15.1

A portion of the sample was calcined in air for 16 hours at 538°C. This material exhibited the X-ray diffraction pattern shown in Table VI.

TABLE V

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I₀</u>
	3.0	29.3	8
5	3.9	22.8	2+
	6.66	13.27	34
	7.10	12.45	100
	7.91	11.18	39
	9.24	9.57	16*
10	9.79	9.04	23
	12.79	6.92	11
	13.60	6.51	5
	14.28	6.20	5
	14.68	6.03	5
15	15.33	5.78	2
	15.83	5.60	7
	17.80	4.98	2
	18.94	4.68	3
	19.32	4.59	8
20	20.09	4.42	21
	21.51	4.13	17
	21.82	4.07	27
	22.17	4.01	13
	22.58	3.94	33
25	23.50	3.79	19
	24.09	3.69	8*
	24.96	3.57	23
	25.55	3.49	11*
	25.93	3.44	73
30	26.82	3.32	20
	27.54	3.24	9
	28.32	3.15	9**
	29.07	3.07	5**
	31.50	2.840	3
35	32.15	2.784	3
	33.31	2.690	6
	34.48	2.601	2
	36.26	2.478	2
	37.03	2.428	2
40	37.75	2.383	6

+ = Non-crystallographic MCM-49 peak

* = Impurity peak

** = May contain impurity peak

TABLE VI

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I_o</u>
	3.9	22.8	6+
5	6.88	12.84	46 sh
	7.11	12.43	100
	7.97	11.10	57
	9.35	9.46	25*
	9.94	8.90	48
10	12.53	7.07	4*
	12.82	6.90	13
	13.41	6.60	3*
	14.30	6.19	36
	14.73	6.01	6
15	15.93	5.56	10
	17.90	4.96	2
	18.98	4.68	3
	19.34	4.59	3
	20.18	4.40	11
20	21.56	4.12	11
	21.86	4.07	18
	22.34	3.98	10
	22.67	3.92	30
	23.68	3.76	17
25	24.94	3.57	15
	25.20	3.53	6*
	25.97	3.43	60
	26.93	3.31	13
	27.79	3.21	11
30	28.56	3.13	8**
	29.10	3.07	3**
	29.60	3.02	1
	31.58	2.83	3
	32.24	2.776	3
35	33.34	2.688	7
	34.59	2.593	3
	36.33	2.473	1
	37.05	2.426	2
	37.79	2.380	4

40

 sh = Shoulder

+ = Non-crystallographic MCM-49 peak

* = Impurity peak

** = May contain impurity peak

EXAMPLE 4

The calcined portion of the product of Example 3 was ammonium exchanged and calcined at 538°C in air for 16 hours to provide the hydrogen form transformation product of the crystalline MCM-49. The Alpha Test proved this material to have an Alpha Value of 286.

EXAMPLE 5

A 10.5 part quantity of gallium oxide was added to a solution containing 1.0 part sodium aluminate, 3.05 parts 50% NaOH solution and 280 parts H₂O. A 25.6 part quantity of HMI was added followed by 56.6 parts of Ultrasil and 1.7 parts of MCM-22 seeds. The slurry was thoroughly mixed.

The composition of the reaction mixture in mole ratios:

	SiO ₂ /Al ₂ O ₃	=	138
	SiO ₂ /Ga ₂ O ₃	=	17.9
	OH ⁻ /SiO ₂	=	0.057
	Na/SiO ₂	=	0.057
20	HMI/SiO ₂	=	0.30
	H ₂ O/SiO ₂	=	18.4

The mixture was crystallized with stirring at 150°C for 10 days. The product was identified as poorly crystalline MCM-49 and had the X-ray pattern which appears in Table VII and Figure 4.

The chemical composition of the product was, in wt. %:

	N	1.89
	Na	0.40
30	Ga	8.5
	Al ₂ O ₃	0.81
	SiO ₂	65.6
	Ash	79.3

with silica/alumina and silica/gallia molar ratios for the product of:

SiO ₂ /Al ₂ O ₃	138
SiO ₂ /Ga ₂ O ₃	17.9

The sorption capacities, after calcining for 3 hours at 538°C were, in wt. %:

5	Cyclohexane, 40 Torr	13.3
	n-Hexane, 40 Torr	11.3
	H ₂ O, 12 Torr	12.3

10 A portion of the sample was calcined in air for 16 hours at 538°C. This material exhibited the X-ray diffraction pattern shown in Table VIII.

TABLE VII

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I_o</u>
	3.9	22.8	6+
5	6.66	13.27	30 sh
	7.08	12.48	100
	7.92	11.17	43
	9.27	9.54	8*
	9.74	9.08	20
10	12.78	6.93	12
	13.75	6.44	6
	14.28	6.20	5
	14.62	6.06	3
	15.78	5.62	8
15	17.99	4.93	3
	18.92	4.69	6
	20.10	4.42	24
	20.86	4.26	9
	21.47	4.14	10
20	21.73	4.09	26
	22.57	3.94	29
	23.53	3.78	22
	24.92	3.57	24
	25.91	3.44	82
25	26.80	3.33	19
	27.43	3.25	14
	28.31	3.15	10
	29.04	3.07	5
	31.59	2.832	8
30	32.17	2.783	3
	33.25	2.694	6
	33.70	2.659	8*
	35.12	2.555	4*
	35.96	2.497	11*
35	36.29	2.476	4
	37.73	2.384	7

sh = Shoulder

+ = Non-crystallographic MCM-49 peak

40 * = Impurity peak

TABLE VIII

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I₀</u>
	3.9	22.8	11+
5	6.89	12.83	40 sh
	7.11	12.43	100
	7.96	11.11	55
	9.40	9.41	10*
	9.94	8.90	47
10	12.81	6.91	10
	14.31	6.19	32
	14.74	6.01	4
	15.94	5.56	12
	17.89	4.96	<1
15	19.00	4.67	3
	19.39	4.58	3
	20.22	4.39	9
	21.56	4.12	9
	21.86	4.07	17
20	22.70	3.92	29
	23.70	3.75	16
	24.99	3.56	14
	26.01	3.43	57
	26.96	3.31	12
25	27.84	3.20	10
	28.60	3.12	5
	29.10	3.07	3
	31.63	2.829	6
	32.28	2.773	3
30	33.39	2.684	7
	33.72	2.658	9*
	35.07	2.559	4*
	35.94	2.499	4*
	36.40	2.468	1
35	37.13	2.422	2
	37.88	2.375	3

sh = Shoulder

+ = Non-crystallographic MCM-49 peak

40 * = Impurity peak

EXAMPLE 6

The calcined portion of the product of Example 5 was ammonium exchanged and calcined at 538°C in air for 16 hours to provide the hydrogen form transformation product of the crystalline MCM-49. The Alpha Test proved this material to have an Alpha Value of 64.

EXAMPLE 7

A solution containing 1 part of $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$, 1.31 parts of 50% NaOH solution and 14.0 parts of H_2O was prepared. To this were added 2.8 parts of Ultrasil precipitated silica followed by 1.48 parts of HMI. The reaction mixture was thoroughly mixed. The composition of the reaction mixture in mole ratios was:

	$\text{SiO}_2/\text{Al}_2\text{O}_3$	=	25.5
15	OH^-/SiO_2	=	0.15
	Na/SiO_2	=	0.39
	HMI/SiO_2	=	0.35
	$\text{H}_2\text{O}/\text{SiO}_2$	=	19.4

The mixture was crystallized for 5 days at 143°C. The product was washed, dried at 120°C and identified by X-ray analysis as MCM-49. It exhibited an X-ray pattern as shown in Table IX and Figure 5.

The sorption capacities, after calcining for 16 hours at 538°C were, in wt. %:

25	Cyclohexane, 40 Torr	8.8
	n-Hexane, 40 Torr	15.9
	H_2O , 12 Torr	13.6

The chemical composition of the product was, in wt. %:

30	N	1.83
	Na	0.27
	Al_2O_3	6.8
	SiO_2	73.8
	Ash	80.5

The silica/alumina mole ratio of the product was 18.4.

The surface area of this material was measured to be 459 m²/g.

A portion of the sample was calcined in air for 16 hours at 538°C. This material exhibited the X-ray diffraction pattern shown in Table X.

5

TABLE IX

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I_o</u>
	3.1	28.5	17
5	4.0	22.2	3+
	6.73	13.14	43 sh
	7.08	12.48	100
	7.92	11.16	42
	9.69	9.13	23
10	12.80	6.91	13
	13.76	6.44	7
	14.27	6.20	6
	14.65	6.05	3
	15.85	5.59	7
15	17.82	4.98	2
	18.92	4.69	3
	19.32	4.59	8
	20.13	4.41	20
	21.48	4.14	12
20	21.82	4.07	31
	22.56	3.94	36
	23.59	3.77	18
	24.91	3.57	22
	25.91	3.44	79
25	26.74	3.33	20
	27.61	3.23	7
	28.25	3.16	8
	29.14	3.06	3
	31.48	2.842	3
30	32.16	2.783	3
	33.26	2.694	6
	33.85	2.648	3 sh
	34.72	2.584	2
	36.26	2.478	2
35	37.00	2.429	2
	37.73	2.384	7

sh = Shoulder

+ = Non-crystallographic MCM-49 peak

TABLE X

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I_o</u>
	3.9	22.8	6+
5	6.91	12.79	38 sh
	7.12	12.42	100
	7.96	11.10	53
	9.94	8.90	39
	12.84	6.90	11
10	14.30	6.19	39
	14.71	6.02	10
	15.92	5.57	12
	18.00	4.93	1
	18.98	4.67	3
15	19.34	4.59	3
	20.17	4.40	10
	21.55	4.12	10
	21.86	4.07	17
	22.67	3.92	27
20	23.69	3.75	15
	24.96	3.57	13
	25.98	3.43	61
	26.93	3.31	13
	27.80	3.21	9
25	28.58	3.12	6
	29.11	3.07	2
	29.63	3.02	1
	31.57	2.834	3
	32.23	2.777	3
30	33.35	2.687	6
	34.60	2.593	3
	36.34	2.472	1
	37.06	2.426	1
	37.83	2.378	5

35

sh = Shoulder

+ = Non-crystallographic MCM-49 peak

EXAMPLE 8

A 2.24 part quantity of 45% sodium aluminate was added to a solution containing 1.0 part of 50% NaOH solution and 43.0 parts H₂O in an autoclave. An 8.57 part quantity of Ultrasil precipitated silica was added with agitation, followed by 4.51 parts of HMI.

The reaction mixture had the following composition, in mole ratios:

	SiO ₂ /Al ₂ O ₃	=	23
10	OH ⁻ /SiO ₂	=	0.21
	Na/SiO ₂	=	0.21
	HMI/SiO ₂	=	0.35
	H ₂ O/SiO ₂	=	19.3

The mixture was crystallized at 150°C for 84 hours with stirring. The product was identified as MCM-49 and had the X-ray pattern which appears in Table XI and Figure 6.

The chemical composition of the product was, in wt. %:

20	N	1.70
	Na	0.70
	Al ₂ O ₃	7.3
	SiO ₂	74.5
	Ash	84.2

The silica/alumina mole ratio of the product was 17.3.

The sorption capacities, after calcining at 538°C for 9 hours were, in wt. %:

	Cyclohexane, 40 Torr	10.0
	n-Hexane, 40 Torr	13.1
30	H ₂ O, 12 Torr	15.4

A portion of the sample was calcined in air for 3 hours at 538°C. This material exhibited the X-ray diffraction pattern shown in Table XII.

TABLE XI

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I_o</u>
	3.1	28.5	18
5	3.9	22.8	7+
	6.81	12.99	61 sh
	7.04	12.55	97
	7.89	11.21	41
	9.80	9.03	40
10	12.76	6.94	17
	13.42	6.60	4*
	13.92	6.36	17
	14.22	6.23	11
	14.63	6.05	2
15	15.81	5.61	15
	17.71	5.01	4
	18.86	4.71	4
	19.23	4.62	6
	20.09	4.42	27
20	20.93	4.24	8
	21.44	4.14	17
	21.74	4.09	37
	22.16	4.01	17
	22.56	3.94	58
25	23.53	3.78	26
	24.83	3.59	22
	25.08	3.55	10
	25.86	3.45	100
	26.80	3.33	28
30	27.53	3.24	21
	28.33	3.15	15
	28.98	3.08	4
	29.47	3.03	2
	31.46	2.843	4
35	32.08	2.790	6
	33.19	2.699	9
	34.05	2.633	5
	34.77	2.580	4
	36.21	2.481	2
40	36.90	2.436	3
	37.68	2.387	8

sh = Shoulder

+ = Non-crystallographic MCM-49 peak

45 * = Impurity peak

TABLE XII

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I_o</u>
	3.2	28.0	9+
5	3.9	22.8	7+
	6.90	12.81	48 sh
	7.13	12.39	100
	7.98	11.08	46
	9.95	8.89	53
10	12.87	6.88	10
	14.32	6.18	36
	14.74	6.01	11
	15.94	5.56	17
	17.87	4.96	2
15	19.00	4.67	5
	19.35	4.59	3
	20.24	4.39	14
	21.06	4.22	5
	21.56	4.12	15
20	21.87	4.06	25
	22.32	3.98	12
	22.69	3.92	41
	23.69	3.76	23
	24.95	3.57	19
25	25.22	3.53	4
	25.99	3.43	90
	26.94	3.31	20
	27.73	3.22	17
	28.55	3.13	11
30	29.11	3.07	3
	29.63	3.01	2
	31.59	2.833	6
	32.23	2.777	4
	33.34	2.687	9
35	34.35	2.611	4
	34.92	2.570	3
	36.35	2.471	2
	37.07	2.425	2
	37.82	2.379	6

40

sh = Shoulder

+ = Non-crystallographic MCM-49 peak

EXAMPLE 9

The calcined portion of the product of Example 8 was ammonium exchanged and calcined at 538°C in air for 3 hours to provide the hydrogen form transformation product of the crystalline MCM-49. The Alpha Test proved this material to have an Alpha Value of 308.

EXAMPLE 10

In two separate experiments, propylene was passed into a reactor containing catalyst at 538°C, 100 KpA (1 atmosphere) pressure, a helium/hydrocarbon ratio of 1.1 and a weight hourly space velocity of 3.10 hr^{-1} . The catalyst of the first experiment was hydrogen-form MCM-22 prepared as in Example 1 of U.S. Patent 4,954,325 (hereinafter Example 12). The catalyst of the second experiment was the Example 6 product. After 20 minutes on stream, the product distribution, in weight percent, was determined to be as shown in Table XIII. Significant propylene aromatization selectivity to benzene is observed for the Example 6 catalyst compared to MCM-22. The benzene yield over the Example 6 catalyst was 7.16 wt.%, compared to 2.64 wt.% for MCM-22.

TABLE XIII
PROPYLENE AROMATIZATION

	Catalyst	<u>MCM-22</u>	<u>Example 6</u>
	Product Dist., wt.%		
5	C ₁	0.35	1.28
	C ₂ =	1.59	8.72
	C ₂	12.82	0.00
	C ₃ = (approx)	0.00	41.87
	C ₃ (approx)	34.58	0.00
10	Iso-C ₄	9.28	2.73
	N-C ₄	2.65	0.00
	Iso+1-C ₄ =	4.58	5.51
	C-C ₄ =	1.72	2.31
	T-C ₄ =	2.49	1.82
15	N-C ₅	0.24	0.10
	Cyclo-C ₅	0.59	0.19
	Iso-C ₅	2.27	0.93
	C ₅ =	2.25	2.94
	C ₆ Par.	1.04	0.52
20	C ₆ =	0.18	0.22
	C ₇ Par. + OL.	0.22	0.12
	C ₈ -C ₁₂ Par. + OL.	0.00	0.00
	C ₁₃ + Par. + OL.	0.00	0.00
	Benzene	2.64	7.16
25	Toluene	9.08	8.10
	C ₈ Ar.	7.52	6.78
	C ₉ Ar.	3.01	3.87
	C ₁₀ -C ₁₁ Ar.	0.29	0.91
	C ₁₂ + Ar.	0.00	0.00
30	Naphthalene	0.38	0.77
	M-Naphthalenes	0.26	3.16

EXAMPLE 11

Sodium aluminate comprising 40 wt.% Al_2O_3 , 33 wt.% Na_2O , and 27 wt.% H_2O was added to a solution containing NaOH and H_2O in an autoclave. Ultrasil precipitated silica was then added with agitation, followed by aminocycloheptane (R) directing agent to form a reaction mixture.

This mixture had the following composition, in mole ratios:

10	$\text{SiO}_2/\text{Al}_2\text{O}_3$	=	33.34
	OH^-/SiO_2	=	0.18
	Na/SiO_2	=	0.18
	R/SiO_2	=	0.35
	$\text{H}_2\text{O}/\text{SiO}_2$	=	18.83

The mixture was crystallized at 143°C for 192 hours with stirring. The product was identified as MCM-49 and had the X-ray pattern which appears in Table XIV and Figure 7.

The chemical composition of the product was, in wt. %:

20	N		1.51
	Na		0.83
	Al_2O_3	4.6	
	SiO_2	74.2	
25	Ash	79.2	

The silica/alumina mole ratio of the product was 27.4.

The sorption capacities, after calcining at 538°C for 9 hours were, in wt. %:

30	Cyclohexane, 40 Torr	7.5
	n-Hexane, 40 Torr	14.0
	H_2O , 12 Torr	13.5

TABLE XIV

	<u>Degrees</u> <u>2-Theta</u>	<u>Interplanar</u> <u>d-spacing (A)</u>	<u>I/I_o</u>
	4.1	21.4	1
5	6.87	12.87	41
	7.14	12.38	100
	7.98	11.09	26
	9.88	8.95	18
	12.85	6.89	14
10	14.00	6.33	10
	14.31	6.19	11
	14.74	6.01	2
	15.88	5.58	13
	17.79	4.99	4
15	18.95	4.68	6
	19.34	4.59	7
	20.20	4.40	18
	21.06	4.22	7
	21.51	4.13	12
20	21.82	4.07	27
	22.63	3.93	46
	23.60	3.77	19
	24.90	3.58	25
	25.14	3.54	7
25	25.92	3.44	90
	26.82	3.32	26
	27.66	3.22	13
	28.43	3.14	12
	29.03	3.08	4
30	29.45	3.03	3
	31.51	2.839	4
	32.15	2.784	5
	33.24	2.695	8
	34.13	2.627	4
35	34.84	2.575	2
	36.26	2.477	3
	36.97	2.431	3
	37.73	2.384	7

CLAIMS:

1. A synthetic crystalline zeolite having, in its as-synthesized form, an X-ray diffraction pattern including values substantially as set forth in Table I below:

5

TABLE I

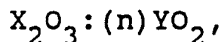
Interplanar d-Spacing (A) Relative Intensity, I/I₀ x 100

	13.15	±	0.26	w-s *
	12.49	±	0.24	vs
	11.19	±	0.22	m-s
10	6.43	±	0.12	w
	4.98	±	0.10	w
	4.69	±	0.09	w
	3.44	±	0.07	vs
	3.24	±	0.06	w

15

* shoulder.

2. The zeolite of Claim 1 and having a composition comprising the molar relationship:

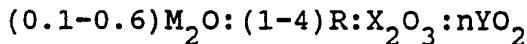


5

wherein n is less than about 35, X is a trivalent element and Y is a tetravalent element.

3. The zeolite of Claim 2 wherein x is 15 to less than 20.

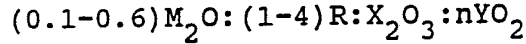
4. The zeolite of Claim 2 having a composition, on an anhydrous basis and in terms of moles of oxides per n moles of YO₂, expressed by the formula:



5

wherein M is alkali or alkaline earth metal and R is an organic moiety selected from cyclopentylamine, cyclohexylamine, cycloheptylamine, heptamethyleneimine, and homopiperazine.

5. The zeolite of Claim 3 having a composition, on an anhydrous basis and in terms of moles of oxides per n moles of YO₂, expressed by the formula:



5 wherein M is alkali or alkaline earth metal and R is hexamethyleneimine.

6. The zeolite of any one of Claims 2 to 5 wherein X is aluminum and Y is silicon.

7. A method of synthesizing the zeolite of Claim 4 comprising crystallizing a reaction mixture containing sources of alkali or alkaline earth metal (M), an oxide of trivalent element X, an oxide of tetravalent element Y, organic directing agent (R), and water, said reaction mixture having a composition, in terms of mole ratios of oxides, within the following ranges:

	YO ₂ /X ₂ O ₃	12	to	<35
10	H ₂ O/YO ₂	10	to	70
	OH ⁻ /YO ₂	0.05	to	0.50
	M/YO ₂	0.05	to	3.0
	R/YO ₂	0.2	to	1.0

8. A method of synthesizing the zeolite of Claim 5 comprising crystallizing a reaction mixture containing sources of alkali or alkaline earth metal (M), an oxide of trivalent element X, an oxide of tetravalent element Y, organic directing agent (R), and water, said reaction mixture having a composition, in terms of mole ratios of oxides, within the following ranges:

	YO ₂ /X ₂ O ₃	15	to	25
10	H ₂ O/YO ₂	10	to	70
	OH ⁻ /YO ₂	0.05	to	0.50
	M/YO ₂	0.05	to	3.0
	R/YO ₂	0.2	to	1.0

9. The method of Claim 7 or Claim 8 wherein the R/M ratio is less than 3.
10. A process for converting a feedstock comprising organic compounds to conversion product which comprises contacting said feedstock at organic compound conversion conditions with a catalyst comprising an active form of the synthetic porous crystalline material of Claim 1.

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FIG. 1a

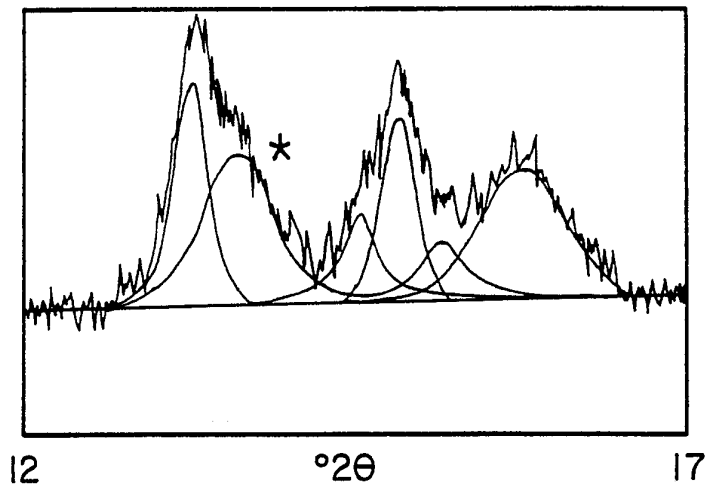


FIG. 1b

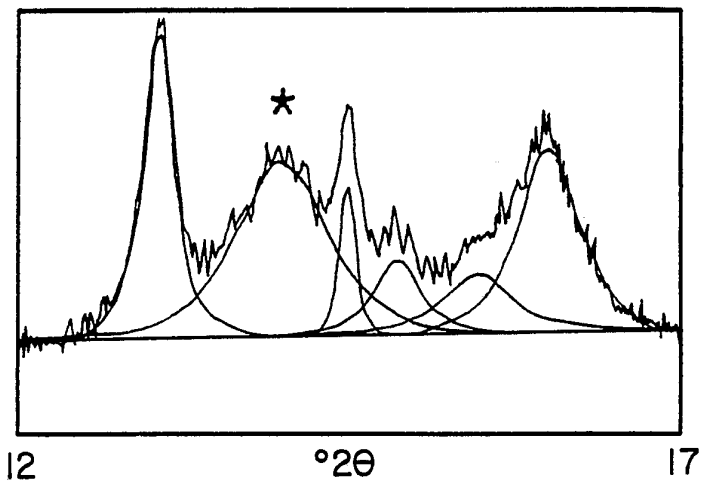
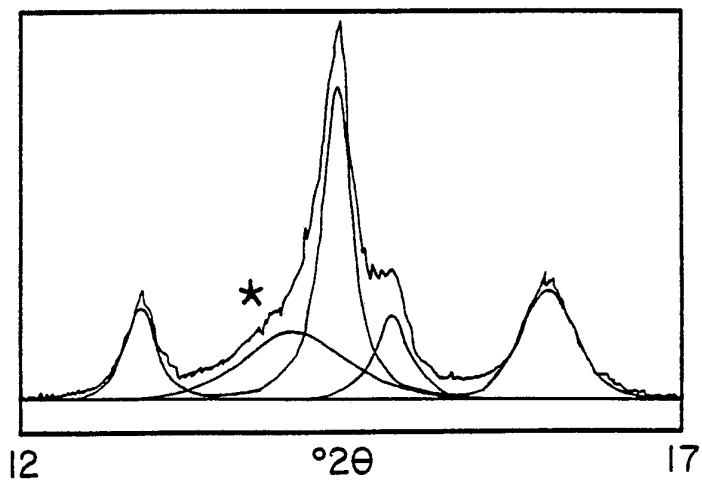


FIG. 1c



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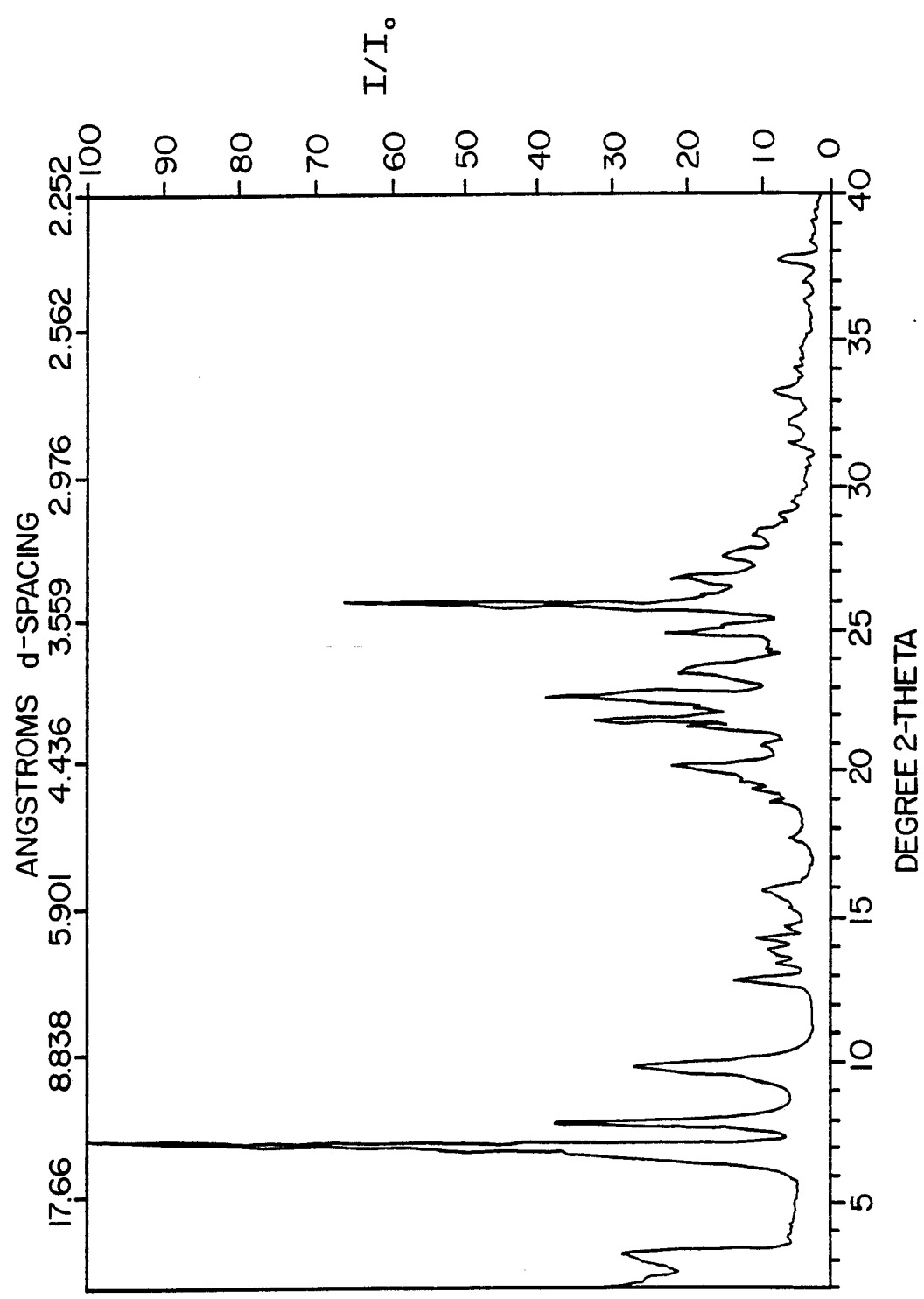


FIG. 2

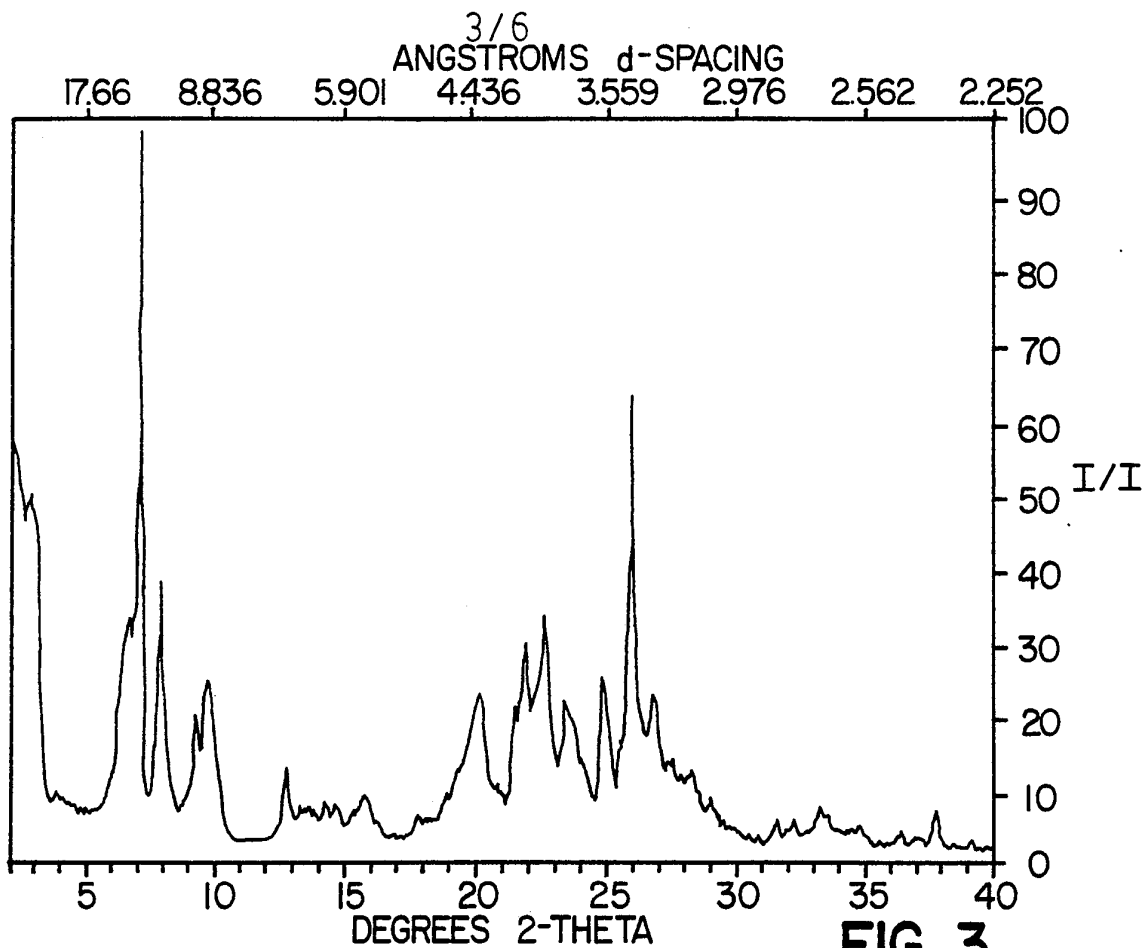


FIG. 3

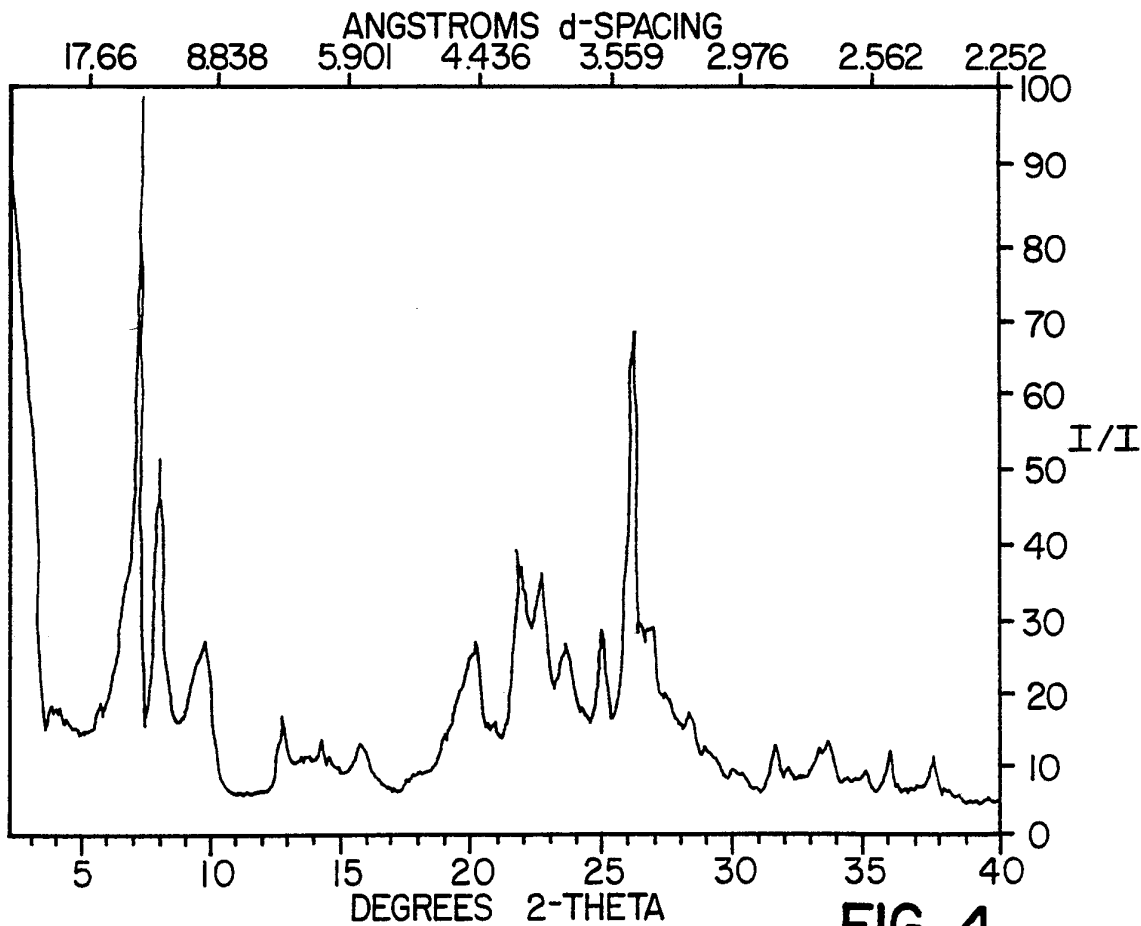
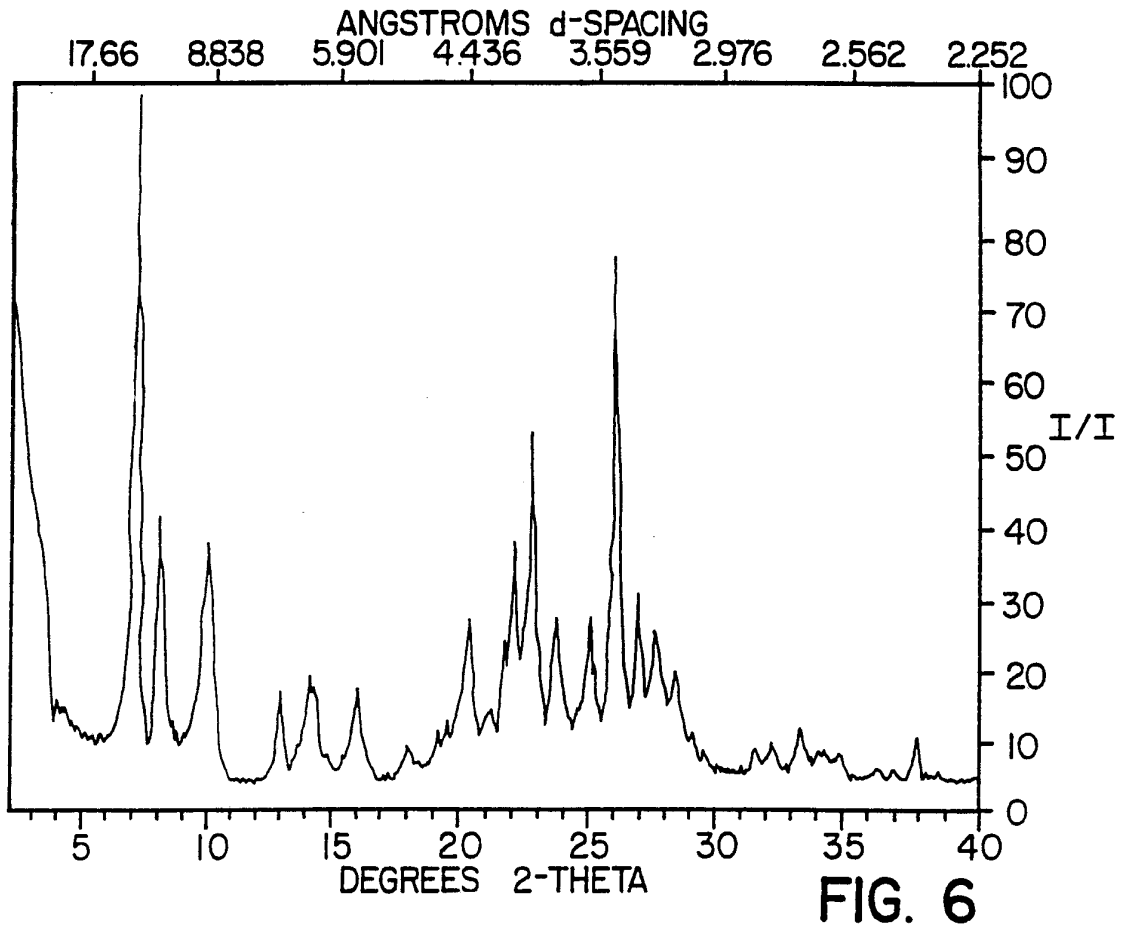
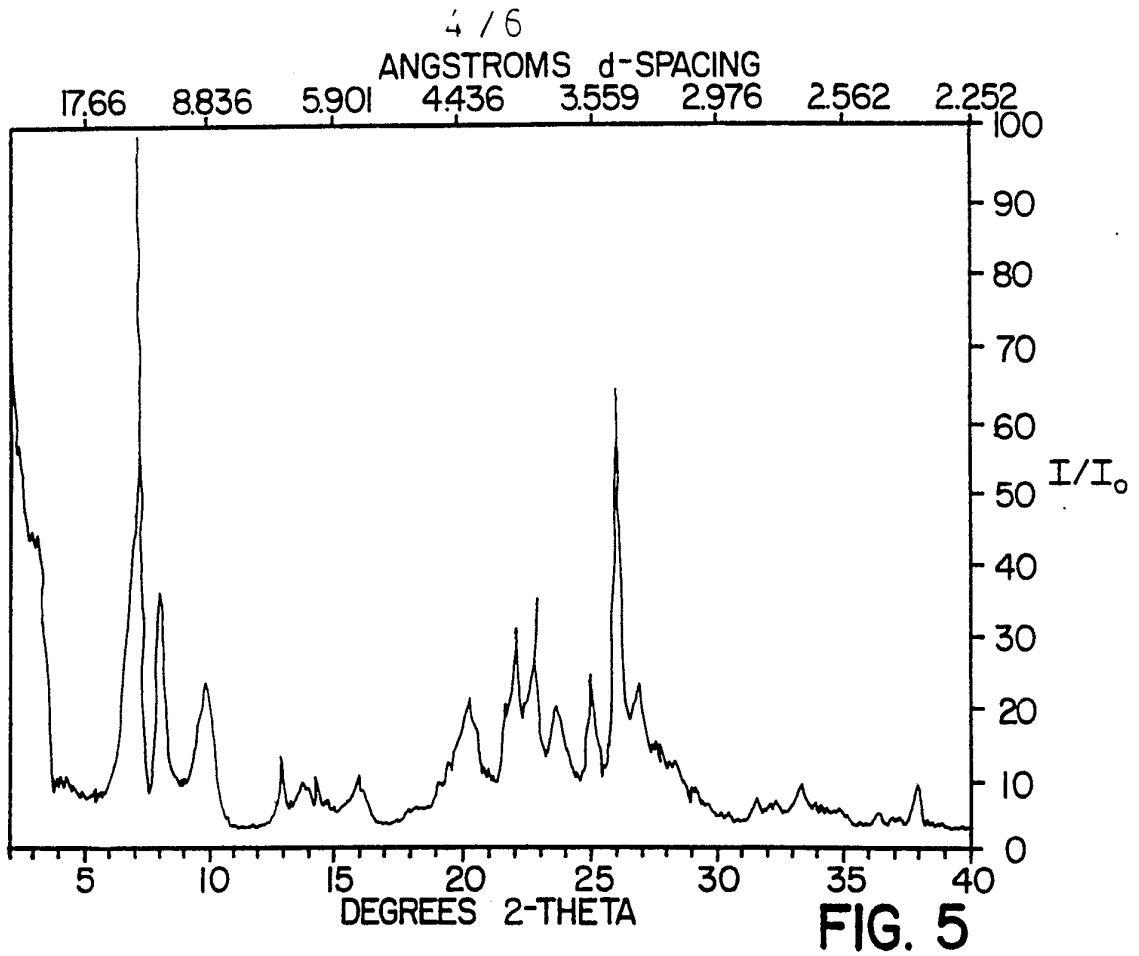


FIG. 4

SUBSTITUTE SHEET



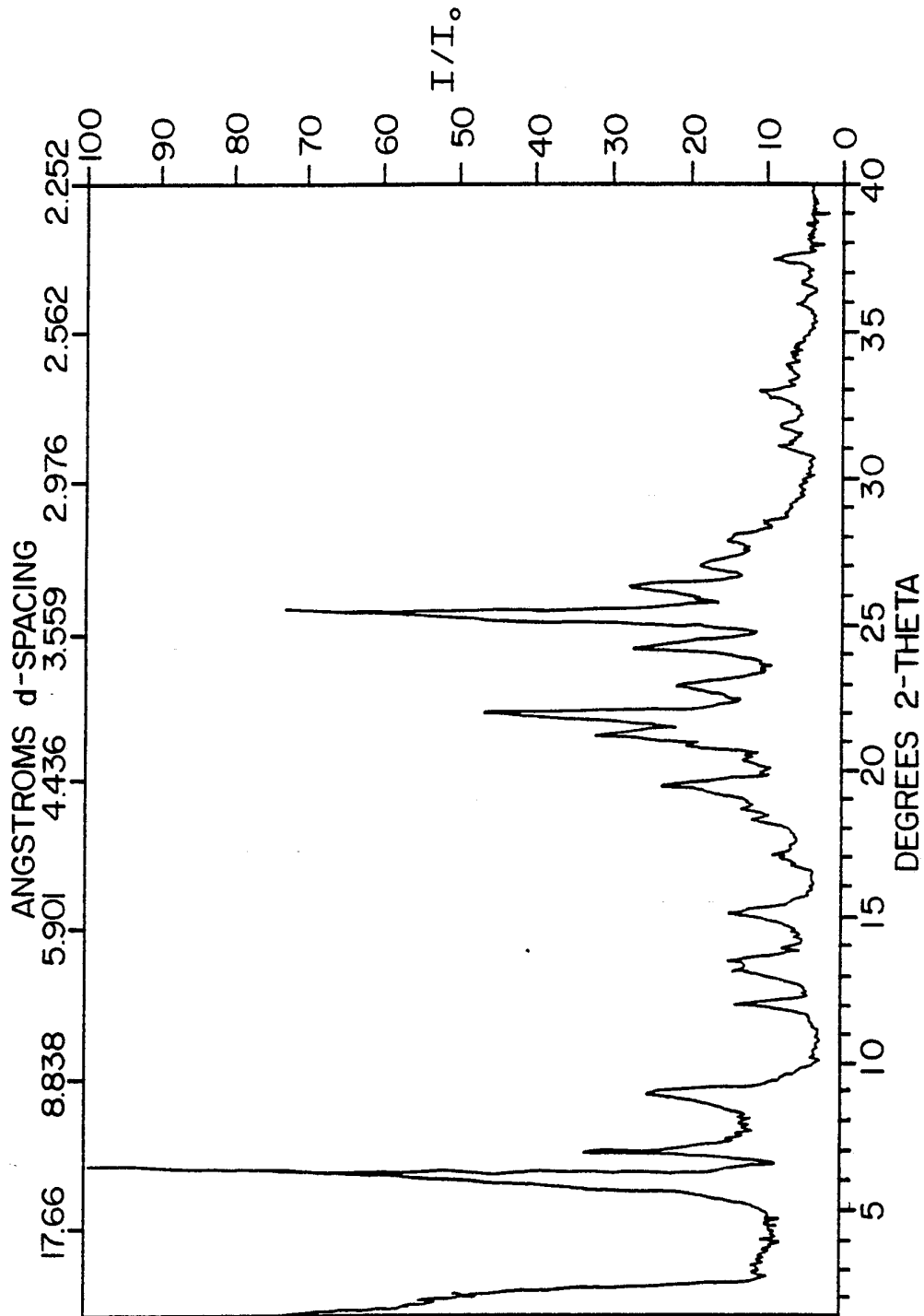


FIG. 7

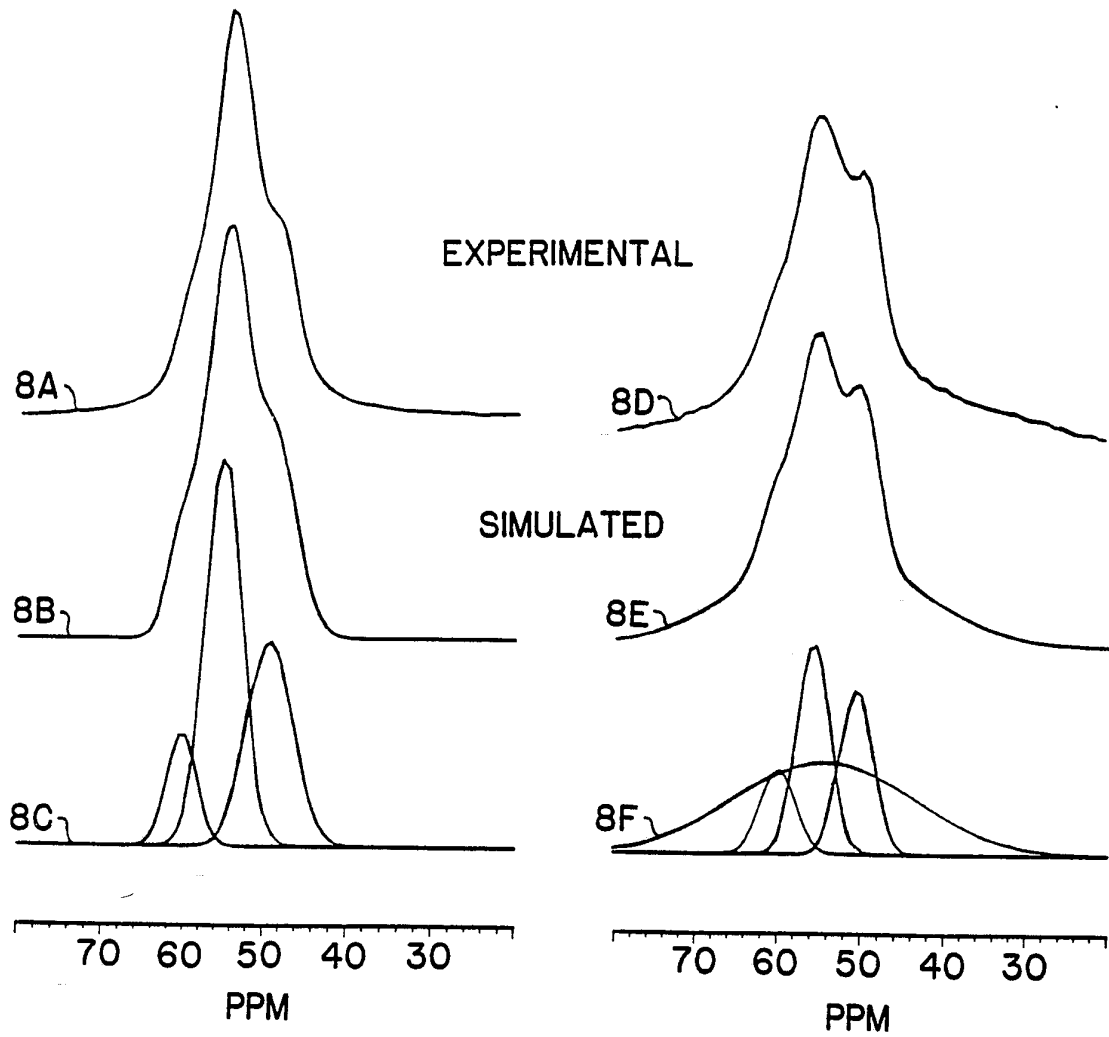


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/05198

A. CLASSIFICATION OF SUBJECT MATTER
 IPC(5) :C01B 33/34; C01G 11/00
 US CL :423/328; 208/46
 According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 U.S. : 423/277,279,326,329,330; 502/77; 208/111,120,135

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
 Unofficial digest of X-ray diffraction patterns

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A, 4,954,325 (RUBIN ET AL) 04 SEPTEMBER 1990 See column 11-13.	10
A	US,A, 4,439,409 (PUPPE ET AL) 27 MARCH 1984 See column 2, lines 16-50.	1-10
A	US,A, 4,826,667 (ZONES ET AL) 02 MAY 1989 See column, lines 34-50.	1-10

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be part of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search: 08 SEPTEMBER 1992
 Date of mailing of the international search report: 23 OCT 1992

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