APPENDIX A

Co CATALYST FORMULATIONS

Prep #	066 Date Fech	3	Amount	200.0 g
Compounds (%wt)	<u> </u>	Russer	254024	Al2O3

Suppo	et y-Alumina VISTA B	Assent	159.00 g	
Partic	le:Size 400 - 0 mesh	Treatment	500°C / 10 hrs	
Cobai	Cobalt Nitrate	Amount	147.97 g	
Metai	Ruthenium Nitrosylnitrate	Amount	3.73 g	
	tor Iron (III) Nitrate	Amount	72.31 g	
Promo		Amount		
Prom	ror :	Amount		

PROCEDURE				
Preparation	X	Incipient Wetness		Wet Impregnation
		Ion Exchange		Other
Notes Incipient wetn	ess: aq	ueous solution of Co, Fe,	Ru	
Dry catalyst p	recurso	r in an oven 115°C / 5 hr	s with stir	ring
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······································				
				•
Calcination Te	mperat	ure 300°C	Time	10 hrs
Notes Af	ter dry	ing, 60 g of catalyst are N	OT to be	calcined!!
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Co.066:

15 wt% Co 5.0 wt% Fe 0.5 wt% Ru γ-alumina

Preparation Procedure:

Calcine the y-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Co nitrate $[Co(NO_3)_2 \cdot 6H_2O]$, Fe (III) nitrate and Ru nitrosil nitrate using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Co, Fe and Ru.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

The dried catalyst is then calcined in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 10 hrs.

Reduction Procedure before Reaction:

Catalyst Prep#	Co.067	Date Tech	May-15-95	Amount	200.0 g
Eampoun (%wt)	d	€e 20	Pd. 2		Al203

Support y-Alumina VISTA B	Amount	156.00 g	
Particle Size 400 - 0 mes	sh Treatment	500°C / 10 hrs	
Cobalt Cobalt Nitrate	Amount	197.29 g	
			_
Metal Palladium (II) Nitrate	Amount	10.01 g	
C. C			_
Promotor	Amount		
Promotoc	Amount		
Promotor	Amount		

Preparation	X	Incipient Wetness		Wet Impregnation
97 - 4 1 00 4 1900 - 19		Ion Exchange		Other
Notes Incipient wetr	iess: aque	eous solution of Co, Pd		
Dry catalyst p	recursor	in an oven 115°C / 5 hrs	with stir	ring
				•
Calcination To	mperatu	re 300°C	Time	10 hrs
80 + 60 to 10 to	4			
Notes A	fter drvir	ig, 60 g of catalyst are NO)T to be	calcined!!
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Co.067:

20 wt% Co 2.0 wt% Pd γ-alumina

Preparation Procedure:

Calcine the γ -alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Co nitrate [Co(NO₃)₂·6H₂O] and Pd (II) nitrate using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Co and Pd.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

The dried catalyst is then calcined in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 10 hrs.

Reduction Procedure before Reaction:

Catalyst Prep #	Co.068	Date Tech	May-24-95	Amount	200.0 g
Gompoun (%wt)	id .	20	Pd 1		Al2O3

Support	y-Alumina VISTA B	Amount	158.00 g	
Particle Si	ze	Treatment	500°C / 10 hrs	
Cobalt	Cobalt Nitrate	Amount	197.29 g	
Metal	Palladium (II) Nitrate	Amount	5.01 g	
Promotor		Amount		
Promotor		Amount		
Prometer		Amount		

PROCEDURE				
Preparation	X	Incipient Wetness		Wet Impregnation
000000,2000 000000 10000		Ion Exchange		Other
Notes Incipient wet	ness: aq	ueous solution of Co, Pd		
Dry catalyst 1	precurso	r in an oven 115°C / 5 h	rs with stir	ring
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				•
Calcination T	emperat	ture 300°C	_ Time	10 hrs
2012				
Notes A	fter dry	ing, 60 g of catalyst are	NOT to be	calcined!!
				<u>.</u>

Co.068:

20 wt% Co 1.0 wt% Pd γ-alumina

Preparation Procedure:

Calcine the γ -alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Co nitrate $[Co(NO_3)_2 \cdot 6H_2O]$ and Pd (II) nitrate using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Co and Pd.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

The dried catalyst is then calcined in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 10 hrs.

Reduction Procedure before Reaction:

Catalyst Prep #*	Co.069	Date Tech	May-24-95	Amount	200.0 g
Compour (%wt)	id	<u>£a</u> 20	Ru 2		Al2O3

Support	y-Alumina VISTA B	Astronome	1.56.00 g	
Particle 5	Size 400 - 0 mesh	Treatment	500°C / 10 hrs	
Cobatt	Cobalt Nitrate	Amounts	197.29 g	
Metal	Ruthenium Nitrosylnitrate	Amount	14.91 g	
				_
Promotor		Amoun		
Promoter	MANA	Amonne		
Promotos		Amount		J

PROCEDURE				
Preparation	X	Incipient Wetness		Wet Impregnation
		Ion Exchange		Other
Notes Incipient w	etness: aq	ueous solution of Co, Fe,	Ru	
Dry catalys	t precurso	or in an oven 115°C / 5 hr	s with stir	ring
				•
				•
Calcination	Temperat	ture <u>300°C</u>	Time	10 hrs
22.00				
Notes	After dry	ing, 60 g of catalyst are N	OT to be	calcined!!
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Co.069:

20 wt% Co 2.0 wt% Ru γ-alumina

Preparation Procedure:

Calcine the γ -alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Co nitrate [Co(NO₃)₂·6H₂O] and Ru nitrosil nitrate using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Co and Ru.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

The dried catalyst is then calcined in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 10 hrs.

Reduction Procedure before Reaction:

Catalyst Prep#	Co.070	Date Tech	Jun-08-95	Amount	200.0 g
Compour (%wt)	nd	€ 0 13			Al2O3

	pert y-Alumina VISTA B	Amount	174.00 g	
Pari	ide Size 400 - 0 mesh	Treatment	500°C / 10 hrs	
-	G 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3		100.01	_
Con	alt Cobalt Nitrate	Amount	128.24 g	
Met		Amount		
III.		THURSE	•	
Pror	noter.	Ашопп		
Prop	noter	Amount		
Pron	notos:	Amount	_	
	44			

Preparation	X Incip	ient Wetness		Wet Impregnation	
	Ion E	exchange		Other	
Notes Incipient	wetness: aqueous so	olution of Co, 60%	of loading	g in 1st step	
Dry cataly	yst precursor in an	oven 115°C / 12 hi	s with sti	rring	
Incipient	wetness: aqueous so	olution of Co, 40%	of loading	g in 2nd step	
Dry cataly	yst precursor in an	oven 115°C / 12 h	s with sti	rring	•
	2002				
Calcination	Temperature	300°C	Time	2 hrs	
Notes	After drying, 60	g of catalyst are N	OT to be	calcined!!	

Co.070:

13 wt% Co y-alumina

Non-promoted catalyst similar to Co.005, with 13% Co.

Preparation Procedure:

Calcine the γ -alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support in 2 steps with an aqueous solution of Co nitrate $[Co(NO_3)_2 \cdot 6H_2O]$, using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with 60% of the desired loading of Co in the first step.

Dry in air at 115°C for 12 hours and calcine in air at 300°C for 2 hours (heating rate of ca. 1°C/min to 300°C).

In the second step, impregnate the remaining 40% of the Co. Repeat the drying and calcination procedures.

Reduction Procedure before Reaction:

Catalyst Prep#	CoW.13	Date Tech	Jun-08-95	Amount	200.0 g
Compani (%wt)	ad	<u>Co</u>	Ru E e 0.5 10		Al2O3

Support y-Alumina VISTA B	Amomie	159.00 g	
Particle Size 400 - 0 mesh	Treatment	500°C / 10 hrs	
Consit Cobalt Nitrate	Amount	98.64 g	
Metal Ruthenium Nitrosylnitrate	Amount	3.73 g	
			_
Promotor Iron (III) Nitrate	Amount	144.63 g	
Promotor	Amount		
Promotor	Amount		

Preparation	- X	Incipient Wetness		Wet Impregnation
		Ion Exchange		Other
Notes Incipient wet	ness: aqu	eous solution of Co, Fe, R	u	
Dry catalyst	precursoi	r in an oven 115°C / 5 hrs	with stir	ring
	•			-
				
Calcination T	emperati	ure 300°C	Time	10 hrs
	cmber ac	300 C	Time	10 MS
WWW.0000000000000000000000000000000000	ftor devi	ng 60 g of optolyct are NC	VT to be	anlaimad!!
***************************************	.fter dryi	ng, 60 g of catalyst are NO	OT to be	calcined!!
***************************************	.fter dryi	ng, 60 g of catalyst are NO	OT to be	calcined!!
N2000000000000000000000000000000000000	.fter dryi	ng, 60 g of catalyst are N(OT to be	calcined!!

CoW.13

10 wt% Fe 10 wt% Co 0.5 wt% Ru

y-alumina

Ru promoted cobalt/iron impregnated on calcined y-alumina similar to CoW.10 (2nd batch).

Preparation Procedure

Calcine γ -alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Fe nitrate [Fe(NO₃)₃.9H₂O], Co nitrate [Co(NO₃)₂.6H₂O] and Ru nitrosylnitrate [Ru(NO)(NO₃)₃.2H₂O] using appropriate quantities to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Fe, Co, and Ru.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried catalyst in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 10 hrs.

Reduction Procedure before Reaction:

Catalyst Prep#	Fe.01	Date Tech	May-05-95	Amount	200.0 g
Compoun (%wt)	đ	Fe 30	Cu 1.5		SiO2

				-
Support	Silica Davison Grade 952	Amount	137.00 g	
Particle Si	2e 400 - 0 mesh	Treatment	500°C / 10 hrs	
Cobalt	Iron (III) Nitrate	Amount	433.88 g	
Metal	Copper (II) Nitrate	Amount	11.40 g	
				_
Promotor		Amount		
Promotor		Amount		
Promotor		Amount		_

AVAMONOS VICES AND	Ion ness: aqueous	pient Wetness Exchange solution of Fe + 0 1 oven 110°C / 16		Wet Impregnation Other	
Calcination To	emperature	<u>500°C</u>	Time	24 hrs	

Fe.01

30 wt% Fe 1.5 wt% Cu Silica

Preparation Procedure of Fe-Cu/Silica

Calcine silica at 500°C for 10 hrs. Use Davisson Grade 952 silica. Presieve to > 38 microns (400-0 mesh). $3H_{2,0}$

Impregnate the support with an aqueous solution of $Fe(NO_3)_3.9H_2O$ and $Cu(NO_3)_2.$H_2O$ using appropriate quantities to yield 30 wt% Fe and 1.5% Cu by weight and to get incipient wetness (ca. 1.2 ml/g).

Dry the catalyst precursor in an oven for 16 hours at 110°C.

The dried catalyst is then calcined in air by raising its temperature at a heating rate of ca. 1°C/min to 500°C and holding for 24 hours.

Reduction Procedure before Reaction:

A mixture of H_2O and H_2 is used for reduction to Fe_3O_4 . Raise the temperature of the bed $10C/\min$ to $400^{\circ}C$ with the feed being $H_2O/H_2 > 0.09$ and maintain these conditions for 48 hrs